Physics Centre of Minho and Porto Universities
Minho pole

Activity Report 2021

February 2022

Contents

1. Introduction

During 2021, the corona virus pandemic continued to influence the normal functioning of research laboratories. However, as happened in 2020, the number of regular journal articles continued to grow (194 in 2021 vs 190 in 2020 and 171 in 2019 for ISI WoK papers), although the conference journal articles continue to decrease (5/17/23 in last three years), which is a consequence of decreased participation in conferences due to the pandemic situation. The average impact factor of the regular journal articles increased significantly (5.25 in 2021 vs 4.02 in 2020), which shows an increase in the visibility of the centre. In published articles, it is worth mentioning the papers in the ACS Energy Letters (IF=23.1), Advanced Functional Materials (IF=18.8), Nano Energy (IF=17.9) and Energy Storage Materials (IF=17.8). At the same time, the distribution of the scientific production among Centre's members remains quite uneven, with a significant percentage of effective members (29%) who published just one paper or none in 2021. The number of effective members of the Centre remained at the same level (67).

As of January 1, 2021, CF-UM-UP became part of the Associated Laboratory - "Laboratory of Physics for Emerging Materials and Technologies (LaPMET)", together the IFIMUP and CeFEMA research centres. Associate Laboratory status was granted until the end of 2025, which can be renewed for more five years. With this statute, it is expected that in the next 3 years 2 researchers will be hired with an indefinite term contract.

Noteworthy is the participation of 24 members of the center in journal editorial boards, being part of them editors of some journals or guest editors of special issues.

The numbers of PhD students, affiliated to the Minho pole of CF-UM-UP, supervised or co-supervised of Centre members continue to grow, (83 in 2021, 76 in 2020 vs 57 in 2019) which justifies dynamism of the Centre and the publication rate increase even with the pandemic situation. On the other hand, part of of the PhD student's growth may be related with the pandemic situation, which forced part of them to extend the thesis and they were not completed within the stipulated period. Consequently, the number of theses completed in 2021 (6) is substantially lower than those completed in 2020 (13), breaking the growth of completed PhD theses we had been having in recent years.

The number of funded projects at CF-UM-UP - Minho remained stable (around 50), with a contracted funding of 2.7 M€. The received funds during 2021 reached 1.7 M€, with a budgetary execution of 1.8 M€ (2.0 M€ in 2020), which was at a good level given the financial difficulties of the University of Minho. The Portuguese agencies, ANI and FCT, remain our principal sources of funding. Funds received from the European Commission in 2021 reversed the downward trend of the last few years, having been the best of the last 5 years. The poor execution of some projects has to do with the difficulties encountered in the contracting processes, which have been too time-consuming.

The global results show a growth in scientific production, which, taking into account the pandemic situation of the last 2 years, reveals a high degree of resilience, associated with a high dedication and effort of the Centre's researchers. Finally, I would like to thank the Group Coordinators for their collaboration, the administrative support Vitor Pacheco and Fernanda Costa, and the help of the technical staff who collaborated in various ways in the operation of the Centre. Although, more limited in time, the support of Cristina Antunes continued to be important.

Luís Rebouta

2. Organization

2.1 Management Entities

Director:
Luís Manuel Fernandes Rebouta

Deputy Director:
Mikhail Igorevich Vasilevskiy

Executive Committee Members:

1. Maria Madalenada Cunha Faria de Lira
2. Paulo José Gomes Coutinho
3. Carlos José de Macedo Tavares

Members of the Scientific Council (effective Minho CF-UM-UP pole members, at 31/12):

	Ana Rita Oliveira Rodrigues	Junior Researcher - Project (until July)
1	Anabela Gomes Rolo	UM teaching staff (Dep. Physics)
2	António Filipe Teixeira Macedo	UM teaching staff (Dep. Physics)
3	António Manuel Gonçalves Baptista	UM teaching staff (Dep. Physics)
4	António Manuel Marques Queirós Pereira	UM teaching staff (Dep. Physics)
5	António Mário Lourenço da Fonseca Almeida	UM teaching staff (Dep. Physics)
6	Armando José Barros Ferreira	Junior Researcher - CFUM
7	Bernardo Gonçalves Almeida	UM teaching staff (Dep. Physics)
8	Bruno António Campos Amorim	Junior Researcher - CFUM
9	Cacilda Maria Lima de Moura	UM teaching staff (Dep. Physics)
10	Carlos José de Macedo Tavares	UM teaching staff (Dep. Physics)
11	Carlos Miguel da Silva Costa	Assistant Researcher - CFUM
12	Clarisse Marta Oliveira Ribeiro	Assistant Researcher - CFUM
13	Claudia Jesus Ribeiro Lopes	Assistant Researcher - CFUM
14	Daniela Patricia Lopes Ferreira	UM teaching staff (Dep. Physics)
15	Diogo Alberto Rocha Lopes	Junior Researcher - Project
	Eduardo Jorge Nunes Pereira	UM teaching staff (Dep. Physics) (until october)
16	Elisabete Maria dos Santos Castanheira Coutinho	UM teaching staff (Dep. Physics)
17	Etelvina de Matos Gomes	UM teaching staff (Dep. Physics)
18	Francisco José Machado de Macedo	UM teaching staff (Dep. Physics)
19	Gaspar José Brandão Queirós Azevedo Machado	UM teaching staff (Dep. Mathematics)
20	Gueorgui Vitalievitch Smirnov	UM teaching staff (Dep. Mathematics)
	Irene Estevez Caride	Assistant Researcher – Project (until december)
21	João Manuel Maciel Linhares	UM teaching staff (Dep. Physics)
22	João Pedro Santos Hall Agorreta Alpuim	UM teaching staff (Dep. Physics)
23	Joaquim Alexandre dos Santos A. de Oliveira Carneiro	UM teaching staff (Dep. Physics)
24	Joel Nuno Pinto Borges	Assistant Researcher - Project
25	Jorge Manuel da Silva Figueiredo	UM teaching staff (Dep. Mathematics)

26	Jorge Manuel Martins Jorge	UM teaching staff (Dep. Physics)
27	José Carlos Viana Gomes	UM teaching staff (Dep. Physics)
28	José Filipe Vilela Vaz	UM teaching staff (Dep. Physics)
29	José Manuel González Méijome	UM teaching staff (Dep. Physics)
30	José Pedro Basto da Silva	Junior Researcher - CFUM
31	Luís António Carvalho Gachineiro da Cunha	UM teaching staff (Dep. Physics)
32	Luís Manuel Fernandes Rebouta	UM teaching staff (Dep. Physics)
33	Luís Manuel Gomes Vieira	UM teaching staff (Dep. Physics)
34	Luís Silvino Alves Marques	UM teaching staff (Dep. Physics)
35	Manuel Filipe Pereira da Cunha Martins Costa	UM teaching staff (Dep. Physics)
36	Maria de Fátima Guimarães Cerqueira	UM teaching staff (Dep. Physics)
37	Maria de Jesus Matos Gomes	UM teaching staff (Dep. Physics)
	Maria Elisabete da Cunha Dias Real Oliveira	UM teaching staff (Dep. Physics) (until june)
38	Maria Madalena da Cunha Faria de Lira	UM teaching staff (Dep. Physics)
39	Mário António Caixeiro de Castro Pereira	UM teaching staff (Dep. Physics)
40	Mário Rui da Cunha Pereira	UM teaching staff (Dep. Physics)
41	Marlene Susana Dionísio Lúcio	Assistant Researcher
42	Marta Maria Duarte Ramos	UM teaching staff (Dep. Physics)
43	Michael Scott Belsley	UM teaching staff (Dep. Physics)
44	Miguel Faria Ribeiro	UM teaching staff (Dep. Physics)
45	Mikhail Igorevich Vasilevskiy	UM teaching staff (Dep. Physics)
	Nuno Miguel Germano Parreira	Assistant Researcher - Project (until november)
46	Nuno Miguel Machado Reis Peres	UM teaching staff (Dep. Physics)
47	Paulo José Gomes Coutinho	UM teaching staff (Dep. Physics)
48	Paulo Rodrigues Botelho Fernandes	UM teaching staff (Dep. Physics)
49	Pedro Libânio Abreu Martins	Assistant Researcher - CFUM
	Peter Michael Schellenberg	Junior Researcher - Project (until November)
50	Raquel Diana Carneiro Alves	Junior Researcher - Project
51	Ricardo Pedro Lopes Martins de Mendes Ribeiro	UM teaching staff (Dep. Physics)
52	Rosa Maria Ferreira Batista	Junior Researcher - CFUM
53	Rui Miguel Soares Pereira	UM teaching staff (Dep. Mathematics)
54	Rute Juliana Ferreira Macedo de Araujo	Assistant Researcher - CFUM
55	Sandra Maria de Braga Franco	UM teaching staff (Dep. Physics)
	Sandra Maria Fernandes Carvalho	UM teaching staff (Dep. Physics) (until february)
56	Sandra Mariana Silva Marques	Junior Researcher - Project
57	Senen Lanceros-Mendez	UM teaching staff (Dep. Physics)
58	Sérgio M. Cardoso Nascimento	UM teaching staff (Dep. Physics)
59	Sergey Pyrlin	Junior Researcher - Project
60	Sofia Oliveira Lopes	UM teaching staff (Dep. Mathematics)
61	Stanislav Lazarov Ferdov	Assistant Researcher - CFUM
62	Stephane Louis Clain	UM teaching staff (Dep. Mathematics)
63	Sylvie Oliveira Ribeiro	Junior Researcher - Project
64	Vasco Manuel Pinto Teixeira	UM teaching staff (Dep. Physics)
62	Veniero Lenzi	Junior Researcher - Project
66	Yuliy Bludov	Assistant Researcher - CFUM

2.2 Collaborators with PhD

Colaborators with PhD – staff members

1.	Jorge António Silva Mendes	Inst. Politecnico Vila do Conde
2.	Júlia Maria Simões Dias Barata de T. Ayres de Campos	UM (Dep. Physics)
3.	Maria Teresa Pitta de Lacerda-Arôso	UM (Dep. Physics)
4.	Mário Jorge Dias Zamith Silva	UM (Dep. Physics)
5.	Martin Andritschky	UM (Dep. Physics)
6.	Teresa Maria Santos Ribeiro Viseu	UM (Dep. Physics)
7.	Vasco Miguel Nina de Almeida	UBI (Dep. Physics)

Other Colaborators with PhD

1	Ana Rita Oliveira Rodrigues	Colaborator (since July)
2	Ana Pedro Lemos Paião	Junior Researcher – Project
3	Cristiana Filipa Almeida Alves	Colaborator (since september)
4	Daniela Maria da Silva Correia	SFRH/BPD/121526/2016)
5	Diego Martinez Martinez	Colaborator
6	Filipe André Peixoto Oliveira	UMINHO/BI/474/2019 (100%)
7	Jaime Eduardo Vieira Silva Moutinho Santos	Colaborator
8	João Pedro Nunes Pereira	Colaborator
9	Margarida Maria Macedo Francesko Fernandes	SFRH/BPD/121464/2016 (70%)
10	Maria José Bastos Pires Lima (since october)	UMINHO/BI/355/2019 (100%)
11	Maria Elisabete da Cunha Dias Real Oliveira	Colaborator (since June)
12	Marcio Correa	Colaborator (since september)
13	Pedro Filipe Ribeiro Costa	SFRH/BPD/110914/2015 (50%)
14	Peter Michael Schellenberg	Colaborator (since november)
15	Sandra Maria Fernandes Carvalho	Colaborator (since february)
16	Kishor Sapkota	Junior Researcher - Project

2.3 PhD Students

Author	Host institution/Program	Scholarship reference	Ongoing/ Terminated	Dedication
Alshaarawi M. A. Salem	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Ana Catarina Branco Lima	PhD Program in Materials Engineering	(SFRH/BD/132624/2017	Ongoing	100%
Ana Isabel Carvalho Amorim de Sousa	PhD Optometry and Vision Sciences	SFRH/BD/136684/2018	Ongoing	100%
André Gustavo Silva Macedo	PhD Program in Materials Engineering	2020.09218.BD	Ongoing	100%
Andreia Esteves Gomes	PhD Optometry and Vision Sciences	SFRH/BD/147336/2019	Ongoing	100%
Andreia Marina de Sousa Almeida	PhD Program in Biomedical Sciences,	SFRH/BD/118721/2016	Completed	30%

	ICBAS, Univ. Porto Concluded: July 2021			
Anita Camillini	Doctoral Program in Physics (MAP-Fis)		Ongoing	25%
António Castro	SURFPROTEC – PhD in Engineering and Surface Protection	SFRH/BD/118721/2016	Ongoing	100%
Balaji Sompalle	Doctoral Program in Physics (MAP-Fis), ECUM	INL	Completed	100%
Beatriz Dias Cardoso	PhD Program in Materials Engineering	SFRH/BD/141936/2018	Ongoing	70%
Belgacem Tiss	PhD Program in Materials Engineering		Ongoing	100%
Bruna Gonçalves	Materials Engineering doctoral program	SFRH/BD/121780/2016	Completed	75%
Bruna Machado da Silva	Doctoral Program in Physics (MAP-Fis)	2021.07277.BD	Ongoing	100%
Bruno Alexandre Alves Santos	PhD Program in Materials Engineering	2020.09630.BD	Ongoing	100%
Bruno Rodrigues Pacheco e Murta	Doctoral Program in Physics (MAP-Fis)	2020.08444.BD	Ongoing	100%
Catarina Isabel da Silva Olveira	PhD Program in Materials Engineering	Own	Ongoing	100%
Celso Joel Oliveira Ferreira	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/149199/2019	Ongoing	100%
Daniela Morais	Programa Doutoral: Engenharia Química e Biológica (FEUP)	SFRH/BD/146476/2019	Ongoing	15%
Diana Isabela Faria Meira	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/143262/2019	Ongoing	100%
Diogo Cavaleiro	Materials Engineering doctoral program	UMINHO/BD/29/2016	Completed	100%
Diogo Coelho da Silva	Doctoral Program in Physics (MAP-Fis)	UI/BD/151181/2021	Ongoing	100%
Diogo Emanuel Carvalho Costa	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/136279/2018	Ongoing	100%
Diogo Jorge Martins Ramos	SURFPROTEC – PhD in Engineering and Surface Protection	UMINHO/BD/56/2018	Ongoing	100%
Dora Nazaré Marques	PhD Optometry and Vision Sciences	2020.05785.BD	Ongoing	100%
Edgar Manuel Neto Carneiro	PhD Program in Materials Engineering	UMINHO/BD/30/2016	Ongoing	100%
Eduarda Barbosa Fernandes	PhD Program in Materials Engineering	SFRH/BD/147938/2019	Ongoing	100%
Eduardo Ínsua Pereira	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Eduardo José de Sousa Pimetel		UIDP/05549/2020 – BID1	Ongoing	25%

Elmahdi Amar	Doctoral Program in Physics (MAP-Fis)	INL	Ongoing	100%
Estela Marisa Oliveira Carvalho	PhD Program in Materials Engineering	SFRH/BD/145455/2019	Ongoing	70%
Filipe Costa Correia	PhD Program in Materials Engineering	SFRH/BD/111720/2015	Ongoing	100%
Francesco Viviano	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Francisca Marçal Queiroz Pinheiro Guedes	PhD in Applied Chemistry		Ongoing	70%
Gonçalo Filipe Santos Catarina	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/138806/2018	Ongoing	100%
Hugo Higino de Barros Machado Martins Salazar	PhD Program in Materials Engineering	SFRH/BD/122373/2016	Ongoing	50%
Iran gomes da Rocha Segundo	PhD Program in Materials Engineering	SFRH/BD/137421/2018	Ongoing	100%
Irina Soraia Rainho Rio	PhD Program in Materials Engineering	2020.04431.BD	Ongoing	70%
Isabel Alves Lopes	PhD in Advanced Materials and Processing - AdvaMTech (IST)	PD/BD/143034/2018	Ongoing	20%
James Caleb Peters	Doctoral Program in Physics (MAP-Fis)		Ongoing	100%
Jessica Rafaela Moreira Gomes	PhD Optometry and Vision Sciences	2020.08737.BD	Ongoing	100%
Joana Catarina Dias Moreira Moreira	PhD Program in Materials Engineering	2021.087096.BD	Ongoing	100%
Joana Margarida Fernandes da Silva Ribeiro	PhD Program in Materials Engineering	SFRH/BD/147221/2019	Ongoing	100%
Joana Marina Silva Queirós	PhD Program in Materials Engineering	2021.08822.BD	Ongoing	100%
João Carlos Pacheco Barbosa	PhD Program in Materials Engineering	SFRH/BD/140842/2018	Ongoing	50%
João Luís Rodrigues Teixeira	PhD Program in Materials Engineering	SFRH/BD/141642/2018	Ongoing	50%
João Miguel Peixoto Oliveira	Doctoral Program in Physics (MAP-Fis)	2021.08158.BD	Ongoing	100%
João Pedro Cruz Serra	PhD Program in Materials Engineering	2021.08158.BD	Ongoing	100%
João Pedro dos Santos Pires	Doctoral Program in Physics (MAP-Fis)	PD/BD/142774/2018	Ongoing	100%
Jorge Manuel Pereira Sousa	PhD in Civil Engineering, EEUM)	2021.08393.BD	Ongoing	33%
José Alexandre Rodrigues Monteiro	PhD Optometry and Vision Sciences	Own	Ongoing	100%

José Diogo Guimarães	Doctoral Program in Physics (MAP-Fis)	UI/BD/151137/2021	Ongoing	100%
Juliana Filipa Gouveia Marques	PhD Program in Materials Engineering	SFRH/BD/112868/2015	Ongoing	100%
Liliana Sofia Correia Fernandes	PhD Program in Materials Engineering	SFRH/BD/145345/2019	Ongoing	100%
Lina María Rodríguez Cely	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Luis Proença Oliveira	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Luísa Fialho	Materials Engineering doctoral program	UMINHO/BD/31/2016	Completed	100%
Marco S. Rodrigues	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/118684/2016	Completed	100%
Maria João Fernandes Faria	PhD Optometry and Vision Sciences	2020.06561.BD	Ongoing	100%
Maria Manuela Carvalho Proença	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/137076/2018	Ongoing	100%
Marina do Carmo Alves	PhD Program in Materials Engineering	2020.06063.BD	Ongoing	100%
Marta Adriana Félix Forte	PhD in Advanced Materials and Processing - AdvaMTech	PD/BD/128491/2017	Ongoing	100%
Marta Sofia Vilela Barreira Teixeira	Doctoral Program in Chemistry, ECUM	2020.04975.BD	Ongoing	30%
Maurício Quintela	Doctoral Program in Physics (MAP-Fis)	INL	Ongoing	100%
Miguel Alexandre Martins Franco	PhD Program in Materials Engineering	SFRH/BD/145741/2019	Ongoing	50%
Nelssom Cunha	Doctoral Program in Physics (MAP-Fis)		Ongoing	100%
Nelson Miguel Macedo da Silva Pereira	Doctoral program in Electronics and Computers Engineering	SFRH/BD/131729/2017	Ongoing	50%
Patrícia Alexandra Pereira da Silva	PhD in Molecular and Environmental Biology	2020.08235.BD	Ongoing	50%
Patrícia Daniela Cabral da Silva	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/128579/2017	Ongoing	100%
Pedro Tiago Maia dos de Reis Jesus	PhD Optometry and Vision Sciences		Ongoing	100%
Rafael dos Santos Pinto	PhD Program in Materials Engineering	2021.07361.BD	Ongoing	50%
Rafael Wagner	Doctoral Program in Physics (MAP-Fis)	INL	Ongoing	30%
Rafaela Marques Meira	PhD Program in Materials Engineering	SFRH/BD/148655/2019	Ongoing	70%
Raquel Gaudência Dias Andrade	PhD Program in Materials Engineering	2020.05781.BD	Ongoing	60%

Ricardo Jorge Brito Gonçalves Pereira	PhD Program in Materials Engineering	SFRH/BD/140698/2018	Ongoing	30%
Ricardo Jorge Cunha Fernandes	PhD Program in Materials Engineering	2021.08418.BD	Ongoing	50%
Ricardo José da Silva Lima	PhD Program in Materials Engineering	2020.07010.BD	Ongoing	100%
Rita de Magalhães Policia	PhD Program in Materials Engineering	2020.07956.BD	Ongoing	100%
Rita Maria Martins Alves	PhD in Molecular and Environmental Biology	2021.07082.BD	Ongoing	60%
Salomé Aurora Parente Pereira.	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Sérgio Abílio Pereira Gonçalves	Doctoral program on electronics and computer engineering	UMINHO/BI/337/2019	Ongoing	50%
Sérgio Rafael da Silva Veloso	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/144017/2019	Ongoing	50%
Telma Campos Domingues	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/08181/2020	Ongoing	30%
Teresa Isabel Marques de Almeida	PhD Program in Materials Engineering	SFRH/BD/141136/2018	Ongoing	70%
Tiago Alves Queirós	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/150646/2020	Ongoing	100%
Tiago André Rodrigues Marinho	PhD Program in Materials Engineering	SFRH/BD/140242/2018	Ongoing	100%
Timothy Albert	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Vera Lúcia Alves Carneiro	PhD Optometry and Vision Sciences	Own	Ongoing	100%
Viviana Lima de Sousa	PhD Program in Materials Engineering	BD/143750/2019	Ongoing	50%
Yelko del Castillo Hernández	Doctoral Program in Physics (MAP-Fis)		Ongoing	100%

2.4 Advisory Board

- Prof. Sir Konstantin Novoselov, School of Physics & Astronomy, University of Manchester, Manchester, United Kingdom.

- Prof. Antti-Pekka Jauho, Department of Micro- and Nanotechnology, Technical University of Denmark, Denmark.

- Prof. Emeritus Denis Weaire, School of Physics, Trinity College, Dublin.

- Prof. Norberto López-Gil, Department of Physics, University of Murcia, Spain.

3. Members of the Centre during 2017-2021 period

Members of the Centre at December 31, 2021

Effective Members with PhD	66
Post-Docs and Collaborators with PhD	23
PhD Students with Minho CF-UM-UP pole affiliation	83

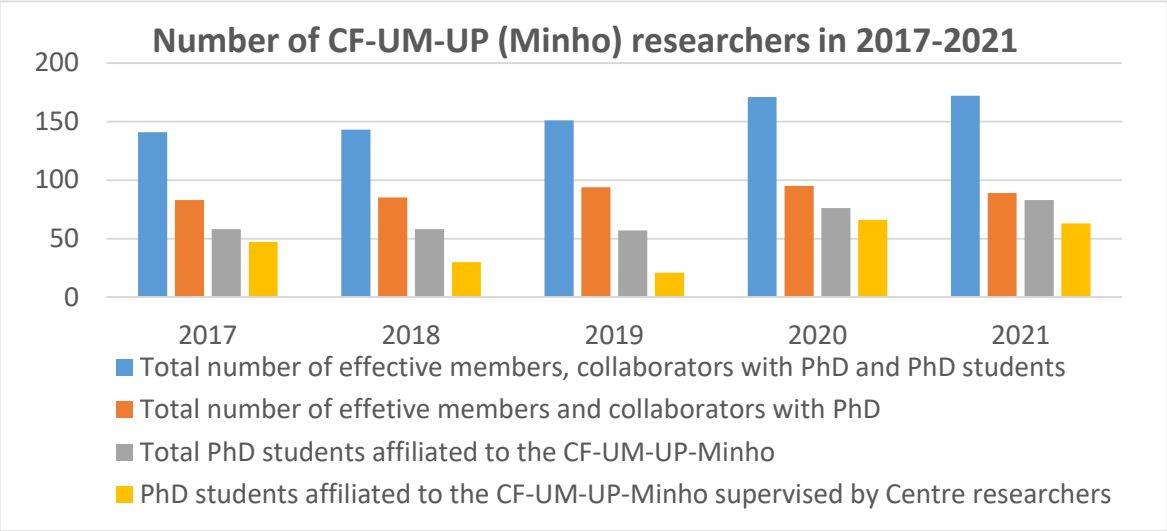

Figure **1: Number of CF-UM-UP (Minho) researchers and PhD students in the last five years**

4. Facilities and Infrastructure

4.1 Research Laboratories

Laboratory – location	Research Line	Responsible
Biophysics – Gualtar	Line 2	Paulo José Gomes Coutinho
Ceramics Research – Azurém	Line 3	Mário António de Castro Pereira
Computational Physics – Gualtar	Line 3	Luís Silvino Alves Marques
Corrosion and electrochemical testings – Azurém	Line 3	Joaquim Carneiro
Crystal Growth – Gualtar	Line 2	Etelvina de Matos Gomes
Doelectric Properties – Gualtar	Line 2	Bernardo Gonçalves Almeida
Electromechanical properties of materials – Azurém	Line 3	Senen Lanceros-Mendez
Femtosecond Laser Spectroscopy –Gualtar	Lina 2	Michael Scott Belsley
Functional Coatings I – Azurém	Line 3	Martin Andritschky
Functional Coatings II – Azurém	Line 3	Luís Manuel Fernandes Rebouta
Functional Coatings III – Azurém	Line 3	José Filipe Vilela Vaz
Infrared Spectroscopy – Gualtar	Line 2	Luís Manuel Gomes Vieira
Magnetic and Electromechanical Properties – Gualtar	Line 2	Bernardo Gonçalves Almeida
Materials Processing – Azurém	Line 3	Stanislav Lazarov Ferdov
Microtopography – Gualtar	Line 3	Manuel Filipe Pereira da Cunha Martins Costa
Visual Optics and Ophthalmic Instrumentation – Gualtar	Line 1	Sandra Maria Braga Franco
Optoelectronics – Azurem	Line 3	Carlos José de Macedo Tavares
Photoconductivity – Gualtar	Line 2	Maria de Fátima Guimarães Cerqueira
Photophysics I – Gualtar	Line 2	Elisabete Maria dos Santos Castanheira Coutinho
Photophysics II – Gualtar	Line 2	Elisabete Maria dos Santos Castanheira Coutinho
Preparation – Azurém	Line 3	Stanislav Ferdov
Preparation I – Gualtar	Line 2	Elisabete Maria dos Santos Castanheira Coutinho
Preparation II – Gualtar	Line 3	Maria de Jesus Matos Gomes
Raman Spectroscopy and Photothermal Measurements – Gualtar - Gualtar	Line 3	Francisco José Machado de Macedo
Research in Clinical and Experimental Optometry – Gualtar	Line 1	Jorge Martins Jorge/José Manuel González Meijome
Science of Vision and Colour – Gualtar	Line 1	João Manuel Maciel Linhares
Surface analysis – Azurem	Line 3	José Filipe Vilela Vaz
Thin Films I – Gualtar	Line 3	Maria Jesus Matos Gomes
Thin Films II – Gualtar	Line 3	Mário António Caixeiro de Castro Pereira
Visual Rehabilitation – Gualtar	Line 1	António Manuel Gonçalves Baptista
Electrofisiology - Gualtar	Line 1	José Manuel Meijome / Paulo Botelho Fernandes
Applied Optics Laboratory - Azurém	Line 2	Luis Rebouta
Raman Imaging and 2D Materials and Devices - INL	Line 2	João Pedro dos Santos Hall Agorreta de Alpuim

5. Indicators of the Centre Performance

5.1 Publications

Publications	Number
ISI papers (regular journal articles/ conference journal articles)	195/5
Books (Book / edited)	0/3
Book chapters	15
Patents (national /international)	1/1
Oral Presentations in International Conferences (total/by invitation)	89/33

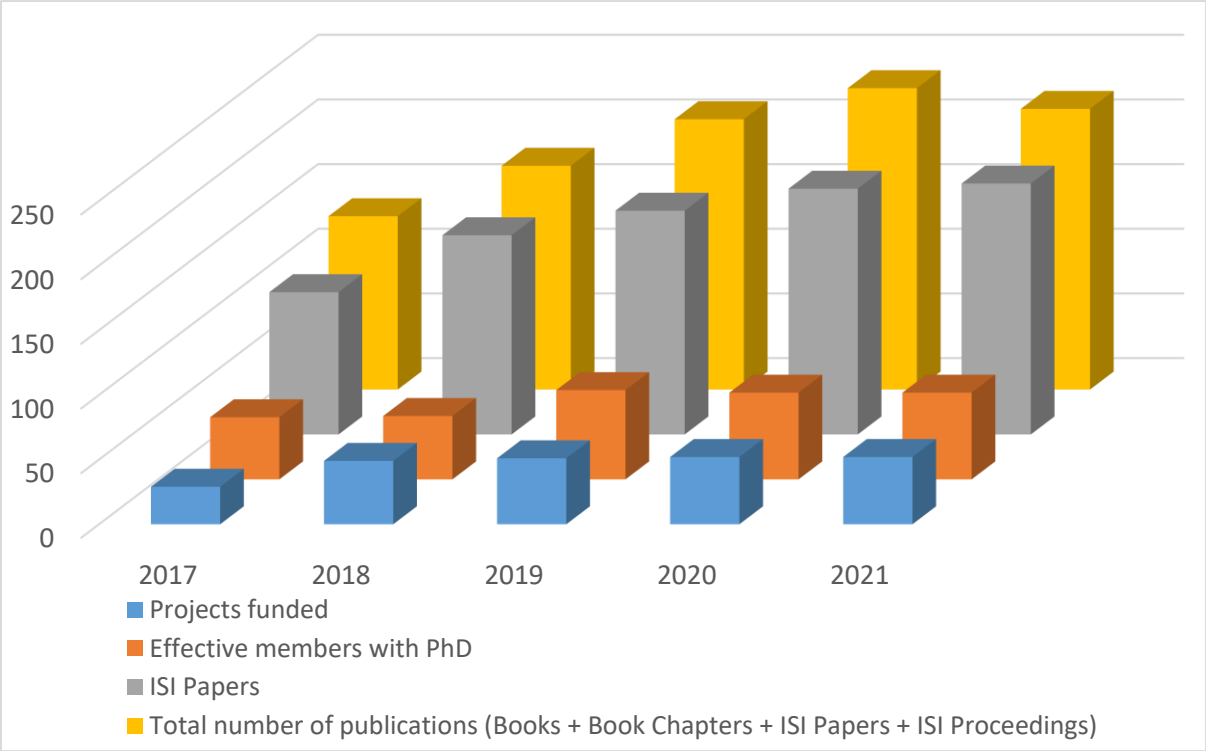

Figure 2: Scientific production, number of members, and number of funded projects

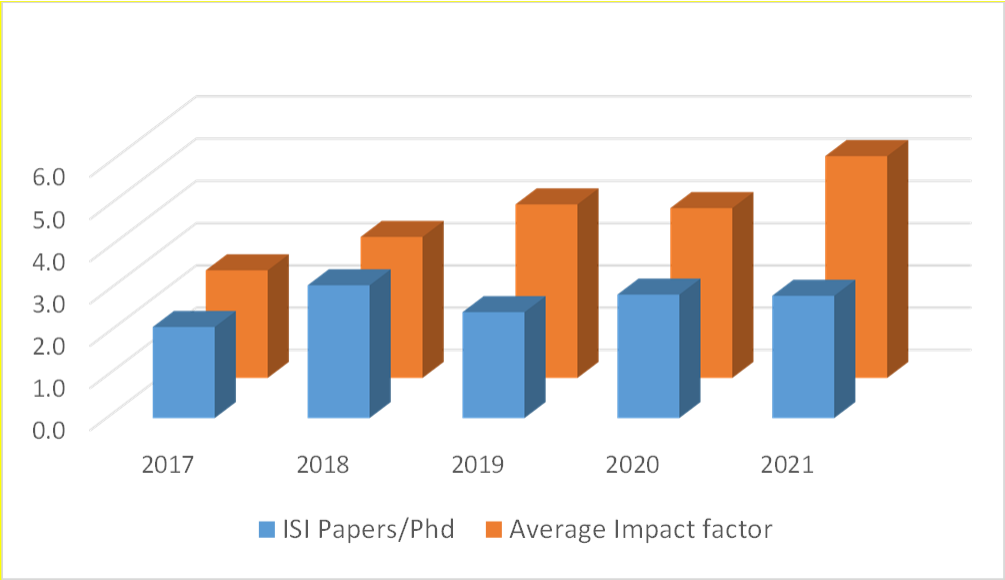

Figure 3: Number of journal articles published (per effective member with PhD) and average impact factor of journals where the articles were published

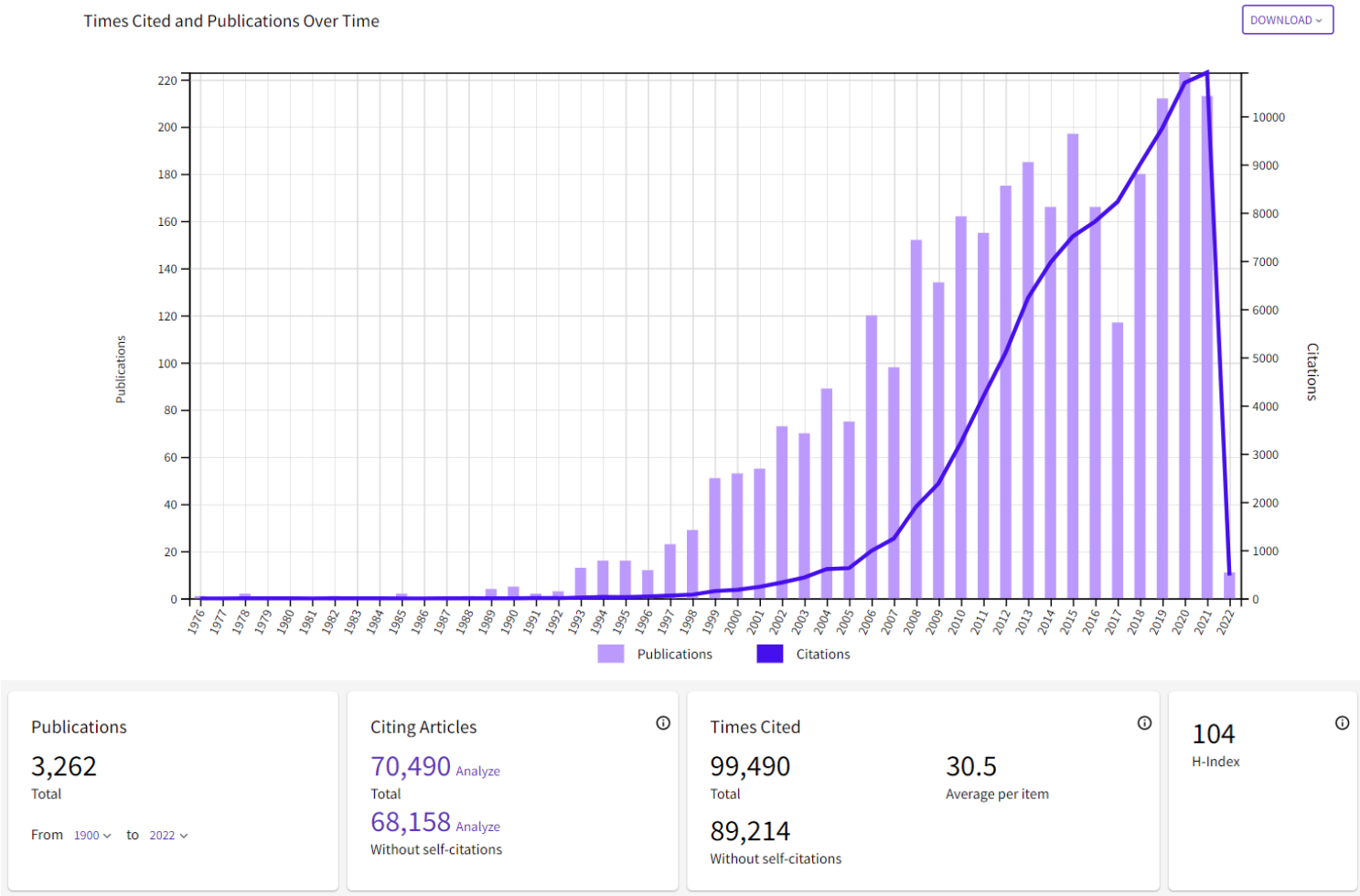

Figure 4: Global data on Centre's publications and citations from ISI Web database

Source: https://www.webofscience.com/wos/woscc/citation-report/f5635b16-242a-4f46-a29d-cff5564279a2-1e32226c

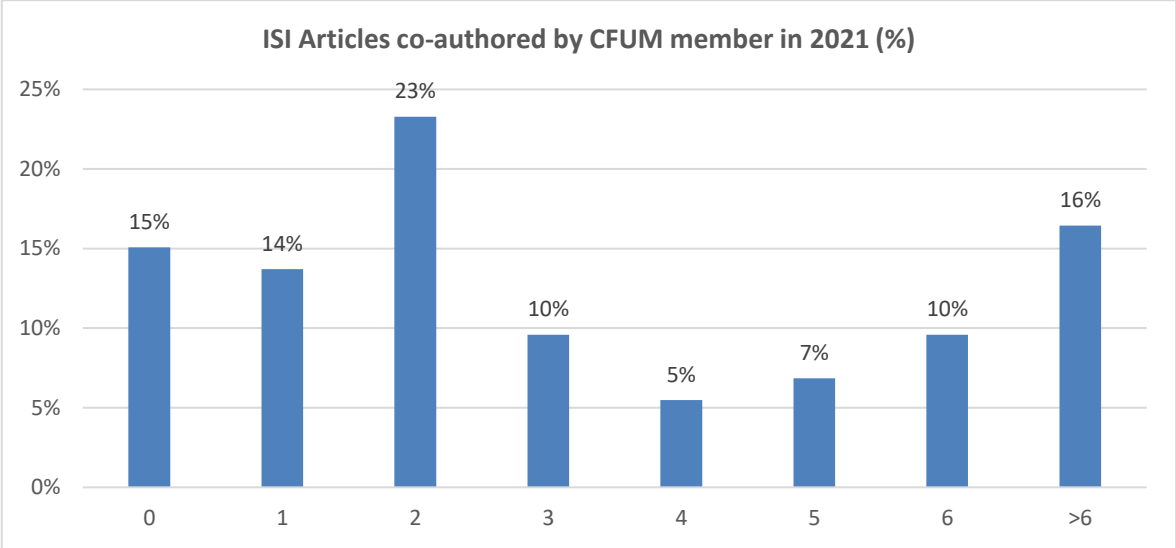

Figure 5: Number of ISI articles co-authored by a PhD member in 2021; statistical frequencies

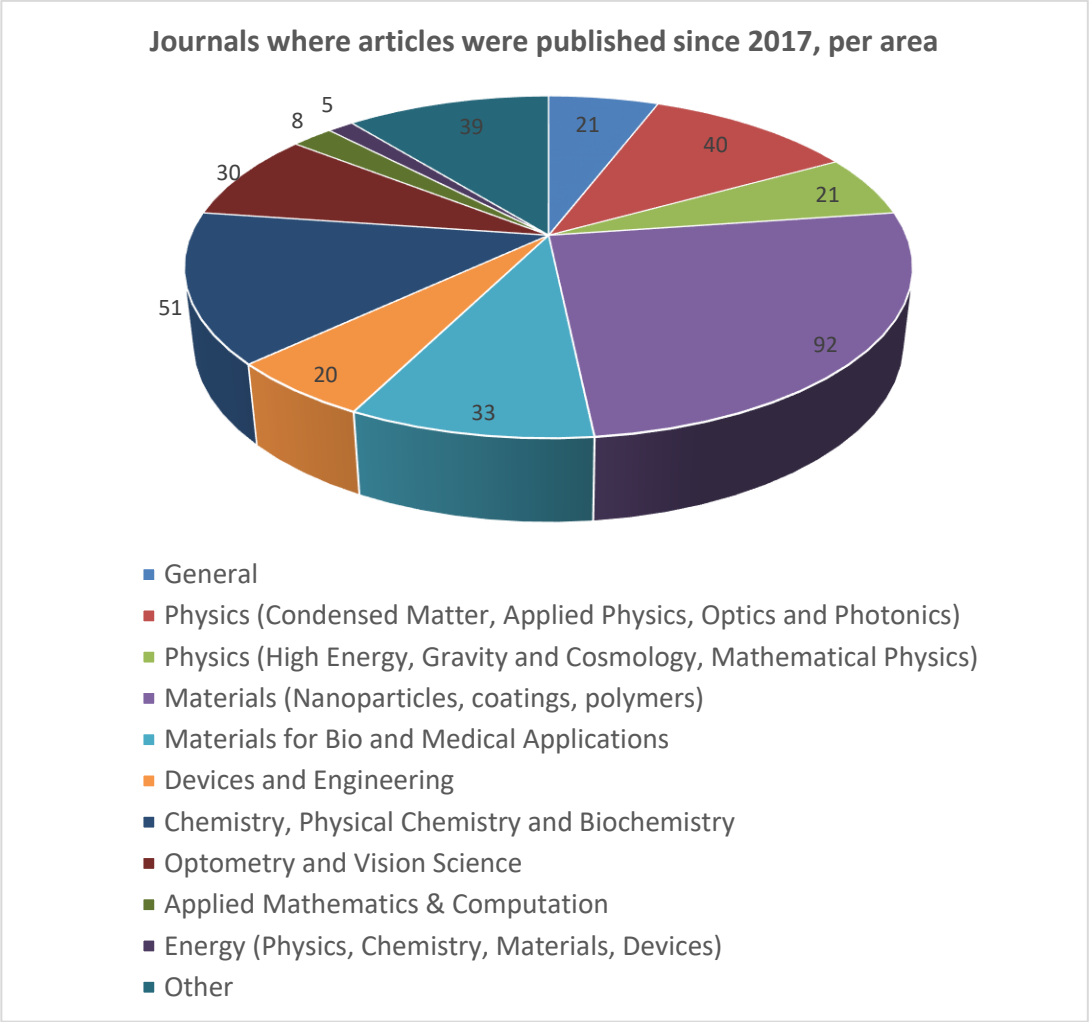

Figure 6: Journals where articles were published since 2017, per area

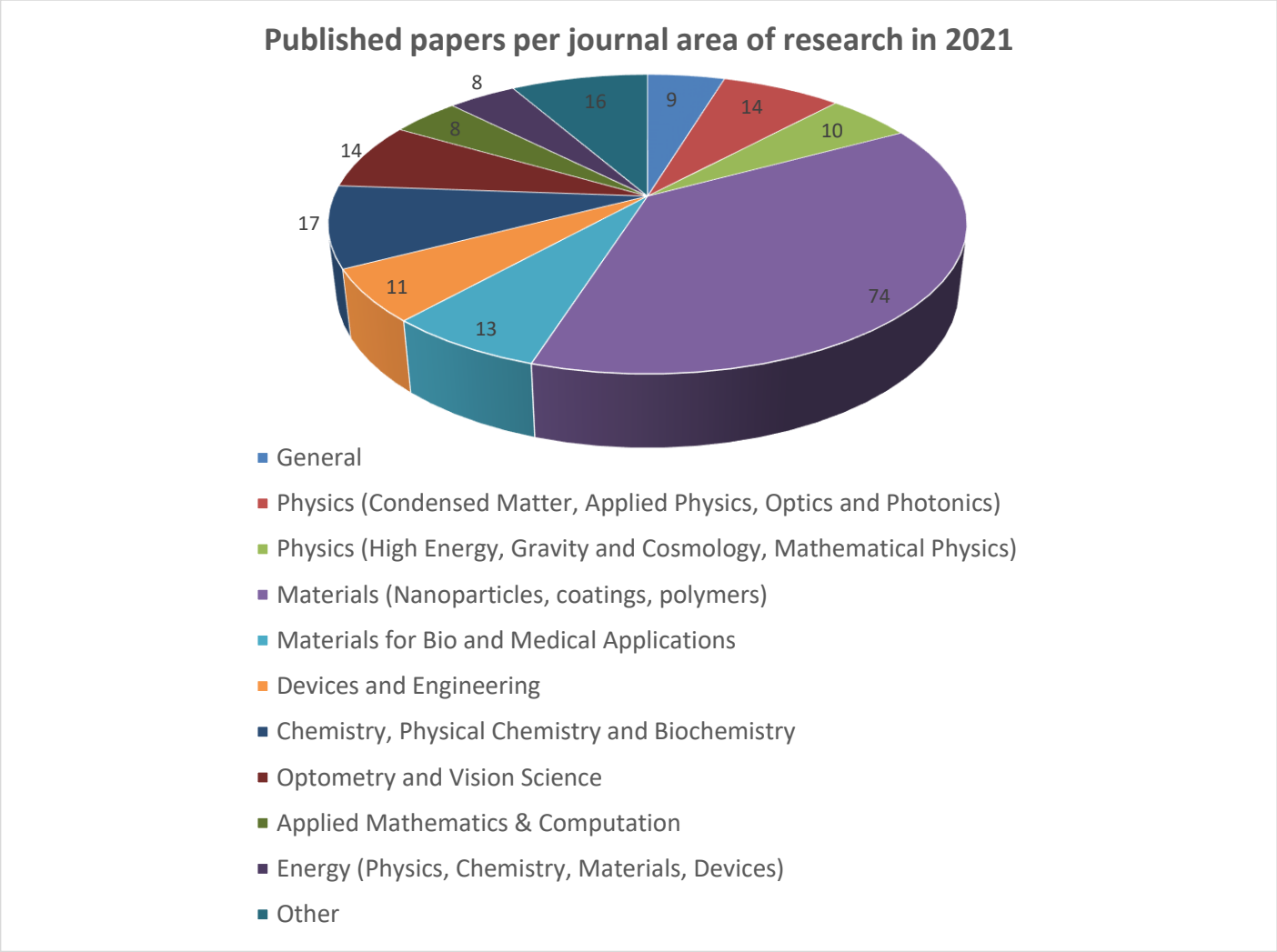

Figure 7: Published papers per journal area of research in 2021

5.2 PhD and MSc degree leading projects at the Centre

MASTER THESES	COMPLETED	39	***total***
PH.D. THESES (affiliated to CF-UM-UP-Minho and supervised /co-supervised by a centre member)	ONGOING	63/20	83
	COMPLETED	5/1	6

5.3 Funding Summary

	Contracted - 2021	%	Received in 2021	%	Executed in 2021	Number of ongoing projects
Strategic Project (FCT)	387,308.31 €	14.11%	52,568.82 €	3.03%	405,043.06 €	2
FCT Projects	847,696.69 €	30.89%	488,054.99 €	28.17%	548,782.56 €	25
ANI Projects	1,157,550.36 €	42.18%	675,998.19 €	39.01%	831,627.79 €	14
Bilateral Projects	3,333.33 €	0.12%	2,000.00 €	0.12%	0.00 €	3
International Proj. (H2020)	348,404.71 €	12.70%	514,181.18 €	29.67%	32,002.11 €	6
Total	**2,744,293.41 €**	**100%**	**1,732,803.18 €**	**100%**	**1,817,455.52 €**	**50**

The contracted value includes overheads and the university's contribution to ANI's projects. The amount received and the amount executed do not include overheads or the university's contribution to ANI's projects. Thus, both the amount received and executed must be significantly smaller than the amount contracted.
The values of the contracted projects were obtained by dividing, in each project, its global financing equally throughout its duration. In terms of the Bosch project, was considered the budget allocated to subprojects P05 and P11, only including the funds for human resources and for the acquisition of equipment and components.

Figure 8: Funding contracted in 2021 according to projects' contracts

Figure 9: Funding executed in 2021

Funding from FCT, shown in Figure 10, is divided into four different items. The first two correspond to unit strategic project funding and individual research projects funded by FCT. The third item includes researchers with a contract paid by the FCT (FCT researchers, both from individual and institutional programs) in which their host research unit is the UMinho pole of the CF-UM-UP. The fourth item in the figure corresponds to the funding of PhD schorlarships and PostDocs directly paid by FCT to grant holders, whose host unit is the UMinho pole of the CF-UM-UP. The funding of research grants and contracts associated with individual projects and with the strategic project are already included in the funding of the respective projects, so they were not taken into account.
In Figure 11 is presented the funding evolution during last five years of individual projets by funding agency.

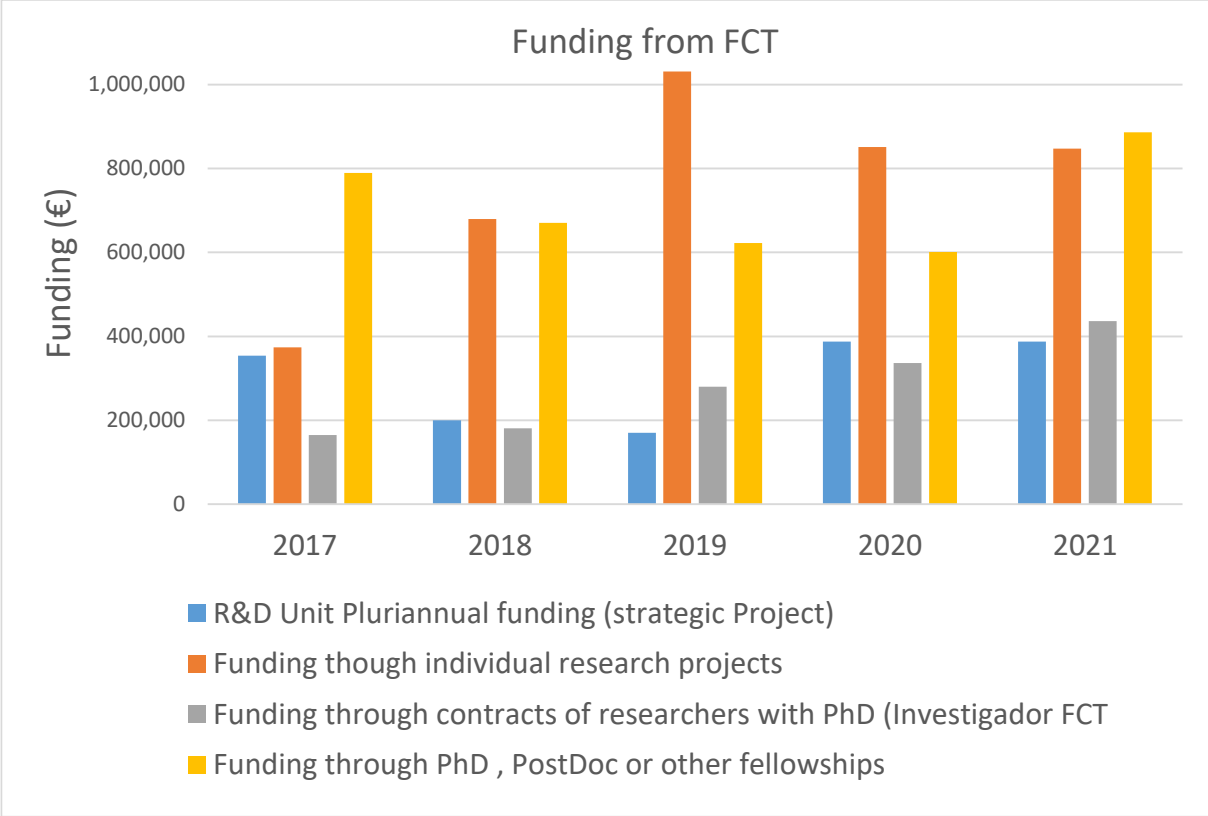

Figure 10: Funding history 2017-2021 (Contracted with FCT)

Figure 11: Funding history 2017-2021 (Contracted projects by funding agency). Values in k€.

5.4 Seminars, Colloquia, Workshops and Conferences organised by the Centre

Colloquia (organised in cooperation with LIP-Minho)

Complete battery Value Chain in Portugal: from mining to recycling- Colloquium
Pedro Salomé, International Iberian Nanotechnology Laboratory
Wednesday, october 20th 2021 at 15h, Physics Amphitheatre, School of Sciences - Building 06 - Campus Gualtar

Protons against cancer: Using charged particles in radiotherapy - Seminar
Patrícia Gonçalves, Instituto Superior Técnico - LIP
Wednesday, june 9th 2021 at 15h, Physics Amphitheatre, School of Sciences - Building 06 - Campus Gualtar

Computação Quantica Fotónica - Colloquium
Ernesto Galvão, International Iberian Nanotechnology Laboratory (INL), Braga
Wednesday, February 24th 2021 at 15h, Online

QuantumMatter@PT network (https://quantummatterpt.weebly.com) online seminars from 2021: QM@PT – Quantum Colloquium in 2021 (vídeos available online at https://educast.fccn.pt/results?channel=27nj70zx8j):

- Branislav J. Nikolic (University of Delaware, Newark & RIKEN, Center for Emergent Matter Science, Tokyo, Japan), "Quantum-Classical Description of Nonequilibrium Electrons Interacting with Dynamical Magnetic Textures in Spintronics and Magnonics" (07/01/2021)
- Francisco Guinea López (Imdea Nanoscience, Madrid, Spain) "Twisted Layers, Narrow Bands and New Phases in Two-dimensional Materials" (11/02/2021)
- Roderick Moessner (Max Planck Institute for the Physics of Complex Systems, Dresden, Germany), "Thermodynamics and Order Beyond Equilibrium - From Eigenstate Thermalization to Time Crystals" (04/03/2021)
- Aires Ferreira (University of York, United Kingdom) "Spin-orbit coupling phenomena in van der Waals materials: perspectives from theory and experiment" (06/05/2021)
- Laurent Sanchez-Palencia (CNRS and Institut Polytechnique de Paris, France) , "From solid-state crystallography to correlated quantum fluids" (09/06/2021)
- Jinhong Park (University of Cologne, Germany), "Universal Principles of Moiré Band Structures" (01/07/2021)
- Robert Jan-Slager (University of Cambridge, United Kingdom),"Using projected Green's functions to understand quasi-periodic topology" (25/11/2021)
- Dr. Juan P. Garrahan (University of Nottingham, United Kingdom), "Large deviations and open quantum dynamics" (16/12/2021)

Scientific Conferences organized by members of the Centre of Physics

- **International**

CIOCV21 -17th International Congress of Optometry and Vision Sciences 2021- Webinar Series -Universidade do Minho; Braga / Online , Sptember to October, 2021.

Yuliy Bludov – Member of Organizing Committee of International Meet on Nanotechnology (NANOMEET2021), Vila Nova de Gaia, Portugal, 13-16 September 2021.

Carlos Tavares: Photocatalytic and Superhydrophilic Surfaces symposium (Topical Symposium 4), 47th International Conference on Metallurgical Coatings and Thin Films (ICMCTF), April 26-30 2021, San Diego, United States (online). (https://icmctf2021.avs.org/). Member of international organizing committee.

Carlos Tavares: 3rd International Workshop Advances on Photocatalysis including Environmental and Energy Applications AdvPhotoCat-EE 2021, ONLINE, June 28-29, 2021 (https://photocatalysis-workshop.eu/). Member of international organizing committee.

Carlos Tavares: Iberian Vacuum Conference RIVA ONLINE 2021, October 4-6 2021. Member of international organizing committee. (https://aseva.es/riva-online-2021/)

Carlos Tavares: 16th European Vacuum Conference (EVC16), Marseille, France, Novemver 22-26 2021. Member of the scientific committee. (https://www.evc16.org/)

J. Nunes-Pereira, Scientific Comittee, GM3DPRIMT2022 – Global Meet on 3D Printing and Additive Manufacturing, 10-12 October 2022, Dubai, UAE.

Manuel Filipe Costa: 18th International Conference on Hands-on Science, Online, July 19-23, 2021, Chairman.

Manuel Filipe Costa: Topical Meeting "Advances and Applications of Optics and Photonics", European Optical Society Annual Meeting 2021, EOSAM2021, Roma, Itália, September 13-17, 2021 (hybrid), Chairman

Manuel Filipe Costa: European Lasers, Photonics and Optics Technologies Summit, Paris, France, September 22-23, 2021 (online), Member of the Scientific Committee

Manuel Filipe Costa: NMCI2021 - The Sixth International Conference on New Material and Chemical Industry, November 13-15, 2021, Online, China, Chair of the Technical Program Committee

Manuel Filipe Costa: 10th International Conference on Knowledge and Education Technology August 12-14, 2021, Tokio, Japan (online), Member of the Technical Program Committee

Manuel Filipe Costa: VII Congresso Internacional de Ensino Universitário, CINDU 2021, 14-17 de Junio del 2021, Universidad de Vigo, Espanha (online), Member of the Scientific Committee

- National

16ª Jornada Científico-Técnica de Contactologia (CONTACTUM2021). Universidade do Minho. Braga (Portugal), February 27, 2021

Bernardo Almeida, Member of Scientific Committee of 4th Symposium on Engineering Physics, DC21 - Doctoral Congress in Engineering, Porto, Portugal, 28-29 June 2021.

Carlos Tavares: Workshop VÁCUO 2021, 9 de novembro de 2021, Instituto Pedro Nunes, Coimbra, Portugal. (https://www.soporvac.pt)

5.5 Awards, prizes, membership in editorial boards of international journals and other forms of recognition by the community

Awards and prizes

Carlos Miguel Costa, Clarisse Ribeiro, José González-Méijome, Nuno Peres, Pedro Martins, Senentxu Lanceros-Mendez, Vasco Teixeira e Yuliy Bludov, researchers of the centre, are part of the llist of the 2% of the most influential scientists in the world over the last year, according to a study by Stanford University (USA) and the Elsevier editorial group. The list is called "World's Top 2% Scientists 2021".

Best Poster Award, INTERMAG 2021 – Poster "Multifunctional Fe-Au Nanostructures for Biomedical Applications", S.C. Freitas, J.H. Belo, C. Sousa, R. Magalhães, H. Crespo, M. Canhota, M.P. Almeida, E. Pereira, B.G. Almeida, B.M. Silva, J.P. Araújo, IEEE International Magnetics Conference, 26-30 April 2021.

Filipe Costa Correia: IUVSTA Elsevier Student Awards, European Vacuum Conference – EVC-16, 22-26 November 2021, Marseille, France.

Joana Margarida Ribeiro: IUVSTA Elsevier Student Awards, European Vacuum Conference – EVC-16, 22-26 November 2021, Marseille, France.

Award of Best Oral Communication in the Symposium on Materials Science and Engineering of DCE21 – 4th Doctoral Congress in Engineering, Luísa Fialho, Faculty of Engineering of University of Porto, 2021.

The research conducted by Centre researcher José Pedro Silva was highlighted by the Central European Research Infrastructure Consortium (CERIC) in its annual report for the year 2020.

Research conducted by researcher José Pedro Silva, is highlighted by the Central European Research Infrastructure Consortium (CERIC). The scientific article with doi: 10.1039/D0TA04984K, reports scientific results of the international consortium obtained in the international infrastructure CERIC. This work was selected as a "highlight" in the ENERGY, MATERIALS SCIENCES area on 26.04.2021

Prémio Fundação Eng. António de Almeida, PhD thesis titled "Selective Photocatalytic Conversions Integrated on a Continuous-flow Microfluidic Process", M J Lima, Porto, 2021

Participation in evaluation panels of funding entities

Pedro Martins - ERC starting Grant (ERC-STG-PE11) evaluator

S. Lanceros-Mendez – ERC Advanced Grant Evaluator. Evaluator in projects in Spain, Poland, Germany and Germany

Appearance in media

José Pedro Silva was interviewed by RUM on the UMinho R&D program and by Porto Canal on the Mentes Brilhantes program due to its developed method to store energy, quickly and with high density.

Participation in journal editorial boards

Sérgio M. C. Nascimento: Editor for Color Vision, Journal of The Optical Society of America

Rute J. Macedo de Araújo: Journal of Contact Lens Research and Science – Associate Editor

António Queirós: Journal of Clinical Medicine. Section Board for 'Ophthalmology' - Associate Editor. https://www.mdpi.com/journal/jcm/sectioneditors/JCM_Ophthalmology

Journal of Ophthalmology. - Academic Editor. https://www.hindawi.com/journals/joph/editors/
Journal of Optometry. Início: 2020/05/01. - Editorial Board. http://www.journalofoptometry.org/en

José M González-Méijome: Journal of Optometry. Função: Editor-in-Chief. https://www.journalofoptometry.org/

Paulo Fernandes: Journal of Ophthalmology. Função: Academic Editor. https://www.hindawi.com/journals/joph/editors/
Journal of Clinical Medicine. Section Board for 'Ophthalmology'. Função: Associate Editor. https://www.mdpi.com/journal/jcm/sectioneditors/JCM_Ophthalmology

Jorge Manuel Martins Jorge: Journal of Optometry – member of editorial board

Mikhail Vasilevskiy: Member of the Editorial Board of the journal Applied Sciences (MDPI), section "Optics and Lasers".

Paulo J. G. Coutinho: Member of the Editorial Board of the journal Materials (MDPI). .

Elisabete M. S. Castanheira Coutinho: Guest Editor of Special Issue "Magnetic Nanoparticle-Based Materials: Synthesis and Biomedical Applications" of the journal Materials (MDPI).
Guest Editors of Special Issue "Advances in Nanomaterials for Drug Delivery" of the journal Biomedicines (MDPI).

Marlene Lúcio: Guest Editor of Special Issue "Overcoming Physiological Barriers Using Lipid Nanosystems" of the journal Pharmaceutics (MDPI).
Member of the Editorial Board of the journal Biophysica (MDPI)

Marlene Lúcio and M. Elisabete C.D. Real Oliveira: Guest Editors of Special Issue "Recent Advances in Research into Vaccine Technologies" of the journal Vaccines (MDPI).

Joel Borges: Guest Editor of Special Issue "Thin Films for Sensing Applications" of the journal Materials (MDPI).
Topic Editor: Nanoplasmonic Thin Films: From Plasmon-Enhanced Light-Matter Interactions to Sensing Applications, of the journal Frontiers in Nanotechnology.

Bernardo Almeida: Editorial Director of "Gazeta de Física".

Carlos Tavares: Coatings, journal, MDPI, Editorial Board Member, since 2020, https://www.mdpi.com/journal/coatings/editors
Special Issue "Thermoelectric Transparent Thin Films for Thermal Energy Harvesting", a special issue of Coatings (ISSN 2079-6412). https://www.mdpi.com/journal/coatings/special_issues/thermoelectr_transparent_film

Pedro Costa: Special Issue "Electronic Skin and Its Strain Sensing Application" from MDPI

Pedro Martins: Polymers MDPI – Guest Editor
Editor Materials mdpi

Vanessa F. Cardoso and Senentxu Lanceros-Méndez: Journal Polymer, special edition "Advances in Polymer-Based Materials and Fabrication Processes for Microfluidic Applications" - Invited editors

Margarida M. Fernandes: Frontiers in Bioengineering and Biotechnology- Review Editor for Industrial Biotechnology

Margarida M. Fernandes and Clarisse Ribeiro: Materials (MDPI) Guest Editors of Special Issue: "Magnetic Responsive Materials for Tissue Engineering and Antimicrobial Applications"

Armando José Barros Ferreira: Special issue of Materials (ISSN 1996-1944) – Guest editor

S. Lanceros-Mendez: Editor Materials, Nanomaterials, Energy, Polymers, IJMS (MDPI); Frontiers in in Bioengineering and Biotechnology (Frontiers); Helliyon (Elsevier); Polymer Crystallization (Wiley)

J. Nunes-Pereira and S. Lanceros-Mendez: Guest Editor - Special Issue "Functional Surface Modification of Polymers", Polymers (ISSN 2073-4360), 2021.

Daniela M. Correia: Javier Reguera; Nanomaterials Journal, MDPI, Guest Editor

Daniela M. Correia, Senentxu Lanceros-Mendez: Nanomaterials Journal, MDPI, Guest Editor

Clarisse Ribeiro: Molecules (MDPI): section board member; Materials (MDPI), special issue "Magnetic Responsive Materials for Tissue Engineering and Antimicrobial Applications": Guest Editor

Joaquim Carneiro: Coatings (MDPI) – Member of the Editorial Board
International Journal of Photoenergy (Hindawy) – Member of the Editorial Board
Solids (MDPI) – Member of the Editorial Board
Current Smart Materials (ISSN: 2405-4658) -Member of the Editorial Board
Special Issue Editor, "State of the Art on Coatings, Thin Films, Nano Materials and Structures: Production and Applications", A special issue of Coatings (ISSN 2079-6412), https://www.mdpi.com/journal/coatings/special_issues/StateOfArt#info

Luís Cunha: Coatings (MDPI) - Editorial Board Member

José Basto:
José P. B. Silva: Guest Editor of Special Issue "Synthesis and applications of ferroelectric thin films" of the journal Materials (MDPI).
https://www.mdpi.com/journal/materials/special_issues/ferroelectric_thin_films

José P. B. Silva and Maria J. M. Gomes: Guest Editors of Special Issue "Non-linear dielectric materials for energy storage capacitors" of the journal Materials (MDPI).
https://www.mdpi.com/journal/materials/special_issues/non_linear_dielectric_materials

Filipe Costa:
Associate Editor, SAGE Open.
Guest Editor Special Issue "Hands-On Science: Developing a Sustainable Education System", Sustainability.
Guest Editor Special Issue "Advances on Applications of Optics and Photonics", Photonics.
Guest Editor Special Issue "Selected Papers from the 5th International Conference on Applications of Optics and Photonics (AOP2021)", Sensors.
Scientific Advisory Board member, International Advisor, Óptica Pura y Aplicada – ISSN-L 0030-3917 / ISSN 2171-8814 edited by the Sociedad Española de Optica.

6. Strategic Research Lines

6.1 Strategic Research Lines

Strategic Research Lines	Coordinator
Assessment and enhancing visual performance	Maria Madalena da Cunha Faria de Lira
Physics of quantum materials and bionanostructures	Paulo José Gomes Coutinho
Functional and smart materials and surfaces for advanced applications	Carlos José de Macedo Tavares

6.2 Scientific Production Indicators by Research Line

	Line 1	Line 2	Line 3	TOTAL
N° Effective Members with Ph.D. (at 31/12)	13	26	27	68
Colaborators with PhD – staff members	1	3	3	7
Other Colaborators with PhD	1	5	10	16
Books (Book/Edited)	0	1	2	3
Book Chapters	1	8	6	15
Regular articles published in ISI Journals	17.5	65.5	112	195
Average Journal Impact factor	2.94	5.07	5.69	5.25
Conference Proceedings (ISI)	2	0	3	5
Invited Talks in Scientific Conferences (International/National)	8/2	6/3	19/5	33/10
Contributive Talks in Scientific Conferences (Internat./National)	7/2	16/4	33/4	56/10
Poster presentation (International/National)	6/0	9/10	12/19	27/29
PhD Theses concluded, affiliated to CF-UM-UP-Minho	1/0	1/1	4	6/1
PhD Theses in progress, affiliated to CF-UM-UP-Minho, at 31/12)	15	27	41	83
Externally funded R&D projects (National sources: FCT, ANI)*	1	16	21	38
Externally funded R&D projects (International sources: H2021)	2	3	1	6
Bilateral Cooperation Projects	0	0	3	3
Participation is special projects (Bosch, Sonae)	0.67	1.17	1.17	3
Collaboration Projects with Industry	0	0	0	0
Patents (National/International)	0/0	0/1	1/0	1/1

*PE projects not included

7. Description of the Main Activities in 2021 by Research Line

7.1 Assessment and enhancing visual performance

7.1.1 Researchers

Principal investigator	Maria Madalena da Cunha Faria de Lira
Members (31/12/2021)	**Effective members** António Filipe Teixeira Macedo António Manuel Gonçalves Baptista António Manuel Marques Queirós Pereira Daniela Patricia Lopes Ferreira João Manuel Maciel Linhares Jorge Manuel Martins Jorge José Manuel González Méijome Maria Madalena da Cunha Faria de Lira Miguel Faria Ribeiro Paulo Rodrigues Botelho Fernandes Rute Juliana Ferreira Macedo de Araujo Sandra Maria de Braga Franco Sérgio M. Cardoso Nascimento **Colaborators with PhD – staff members** Vasco Miguel Nina de Almeida **Colaborators with PhD – Other colaborators** Kishor Sapkota **PhD students (affiliated to CF-UM-UP-Minho and supervised by Centre researchers)** Alshaarawi M. A. Salem Ana Isabel Carvalho Amorim de Sousa Andreia Esteves Gomes Dora Nazaré Marques Eduardo Ínsua Pereira Francesco Viviano Jessica Rafaela Moreira Gomes José Alexandre Rodrigues Monteiro Lina María Rodríguez Cely Luis Proença Oliveira Pedro Tiago Maia dos de Reis Jesus Rita Maria Martins Alves Salomé Aurora Parente Pereira. Timothy Albert

	Vera Lúcia Alves Carneiro

7.1.2 Brief description of the scientific work carried out within the Research Line in 2021

In 2021, the research line "in Assessment and Enhancement of Visual Performance" highlight the full implementation of the Opto-Biomechanical Eye Research Network (Project OBERON 956720) Marie Skłodowska-Curie Actions (MSCA) with the participation and coordination of the members of this strategic line. The selection of PhD candidates for the network was successfully completed allowing the hiring of 2 international PhD students and the holding of the 1st annual meeting with the presentation of the work of the different researchers. The work involving visual electrophysiological strategies applied to different areas of visual correction and modeling of the retinal response to visual stimuli continued, mainly the evaluation of the electrical activity of the retina to light stimulus with different wavelengths, and with different customized optical strategies. From the results of this research, an international clinical trial of a new strategy to control myopia started at the end of 2021 and will continue during the next 3 years, with the involvement of CFUM members. Another clinical trial conducted at CFUM during the last 6 years has finished and the publications of that results have been highlighted at different international conferences and published in renowned international journals. Indeed, the scientific production in cooperation with different international companies is to be highlighted, including the participation of several CFUM members in the BOSCH-UMinho partnership involving intellectual property protection and publications in international conferences and journals.

Another area of the main research activity was developed under the project financed by the FCT "LensUM". Its specific objective is to study the dynamic and real-time changes in the optical and geometric properties of the eye with an ocular accommodation. Among the studies carried out, the adaptation of the aberrometer for the assessment of these properties in the peripheral retina is highlighted. Also of note is the application of optical tomography to measure the geometric and optical changes of the lens with accommodation.

Color vision research outcomes were focused on the assessment of color vision and human perception of natural scenes and paintings for normal and deficient chromatic observers. The acquired knowledge was applied in the perception of colors in natural scenes by color vision deficient observers and the impact of using corrective coloured lenses.

In the coming years, an increase in the global contact lenses (CL) market is expected as individuals with myopia and presbyopia will show a significant increase and CL can have an adverse environmental impact, resulting from the need to discard them and their packages every day. As CL aren't biodegradable, they are mainly deteriorated and transformed into microplastics. A project that combines collaborative efforts of a multidisciplinary team has the principal goal to develop a new value-added product using this material as the basis. The first task focuses on the development and implementation of a retrieval network (drop-off points) of used and out of date CL and it was successfully implemented at the end of the year.

Due to the pandemic crisis caused by COVID 19, the number of students who finished their master's thesis and PhD thesis was below levels of previous years. For the same reason, the participation of members of the Research Line in international conferences was almost non-existent, with limited participation in on-line events. The International Conference of Optometry and Vision Science (CIOCV) was only held in the format of online sessions with a smaller number of lectures and other meetings co-organized by research line members had to be postponed.

It is also to be highlighted the level of internationalization in the scientific cooperations, observable in the multinational authorship of the research papers published as well as the close interaction with other national departments and research centers.

We can finally also highlight that the University of Minho is among the twenty best institutions worldwide in the teaching of Optometry and Vision Sciences, being the only one in the European Union. The ranking published in the Journal of Clinical and Experimental Optometry assessed 245 universities from 46 countries in terms of the impact of scientific publications in the area. This result recognizes the UMinho in the international vanguard of teaching and research, attracting human capital and projects that take the good name of the Portuguese optometry to the whole world.

7.1.3 Future research summary

The future development of the research activity will continue to be focused in the most of the referred activities although the group also intends to focuses on several emerging interdisciplinary areas of Vision Sciences in the close future including artificial vision, neuronal visual processing, colorimetry applied to visual stimuli and new materials, creation and optimization of imaging and image visualization systems in visual health and in high-performance environments, visual ergonomics, vision and sport, among others.

Besides the clinical trials mentioned above, other clinical trials are being negotiated with different companies in Europe and Asia. In addition to this virtuous cooperation with the private sector the future development of the research activity will continue to be focused in the most of the referred activities. The results expected from the Project OBERON will allow to open new funding approaches and cooperation opportunities in the field of visual optics and biomechanics. The work in visual electrophysiology will also be continued by consolidating electrophysiology to study retinal activity with different stimuli in different optical conditions, with the intention of expanding it to the study of accommodation, light-eye interaction, and evaluation of the visual cortex with different visual stimulation paradigms.

In addition to the aforementioned applied research, other fundamental targets are being addressed involving medialization and design of innovative optical solutions for visual correction using different platforms, computational models of vision to conduct computational trials for new modalities of visual correction as well as the investigation of how the customized optical stimulation involving different changes in visual stimulation and image quality affect the visual process at the retinal and cortical level, connected but not limited to their role in refractive error development and management.

In the project "LensUM" it is intended to continue with this project, applying it to the study of different conditions. We also intend to proceed with the study of ocular accommodation in other aspects.

Understanding and measuring the color perception of normal and color vision deficient observers was also considered for funding with an FCT exploration project that will start in January 2022 and named "Color Vision test supported by neural networks".

It is also estimated an extension in research and an increase of publications in the area of environmental conservation with the study of recycling of contact lens materials which is expected to bring important contributions in the area of environmental sustainability.

It is expected that in 2022 the International Conference of Optometry and Vision Science will be held again in person, thus allowing the presentation and dynamization of the research carried out in the line “Assessment and Enhancement of Visual Performance”, with the exhibition of the results obtained by students and teachers as well as for the establishment of new cooperation opportunities.

It is also expected that the members of the research line are able to successfully apply to the coming national and international funding project calls and it is expected that these financing allow the group to strength the technical capabilities and also develop new partnerships. Current strategies under development within this research line should allow to create laboratorial facilities of access to all members where newer instrumentation can be acquired and allocated.

7.1.4 Publications

7.1.4.1 Regular articles published in ISI/Scopus Journals

Acanthamoeba keratitis: a review of biology, pathophysiology and epidemiology. de Lacerda AG, & Lira M. 2021 Ophthalmic Physiol Opt; 41: 116-135. https://doi.org/10.1111/opo.12752.

Accommodative and binocular vision dysfunctions in a Portuguese clinical population.. Franco, S., Moreira, A., Fernandes, A., & Baptista, A. J Optom. 2021; doi:10.1016/j.optom.2021.10.002

Association between Clinical Vision Measures and Visual Perception and Soccer Referees' On-field Performance. Baptista, A. M. G., Serra, P. M., Faisal, M., & Barrett, B. T. Optom Vis Sci, 2021;98(7), 789-801. doi:10.1097/opx.0000000000001722

Biometric and ICL-related risk factors associated to sub-optimal vaults in eyes implanted with implantable collamer lenses.. Cerpa Manito, S., Sánchez Trancón, A., Torrado Sierra, O., Baptista, A. M., & Serra, P. M. Eye Vis (Lond), 2021;8(1), 26. doi:10.1186/s40662-021-00250-6

Blue light blind-spot stimulation upregulates b-wave and pattern ERG activity in myopes Amorim-de-Sousa, A., Schilling, T., Fernandes, P., Seshadri, Y., Bahmani, H., & González-Méijome, J. M. Scientific reports, 2021; 11(1), 9273. https://doi.org/10.1038/s41598-021-88459-2

CLEAR - Orthokeratology.Vincent, S. J., Cho, P., Chan, K. Y., Fadel, D., Ghorbani-Mojarrad, N., González-Méijome, J. M., Johnson, L., Kang, P., Michaud, L., Simard, P., & Jones, L. Contact lens & anterior eye; 2021;44(2), 240–269. https://doi.org/10.1016/j.clae.2021.02.003

Improvement of Vision and Ocular Surface Symptoms With a Scleral Lens After Microbial Keratitis. Macedo-de-Araújo RJ, McAlinden C, van der Worp E, González-Méijome JM. Eye Contact Lens. 2021;47(8):480-483. doi: 10.1097/ICL.0000000000000794. PMID: 33928923.

Interactions between contact lenses and lens care solutions: Influence in optical properties. Micael Alves, Elisabete M.S.Castanheira, Madalena Lira. Contact Lens and Anterior Eye 44 (2021). Article 101414 https://doi.org/10.1016/j.clae.2021.01.009

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Other Articles

International Contact Lens Prescribing in 2020. José M. González-Méijome (Contact Lens Spectrum, Issue January 2021)

Adaptação de lentes de contacto em 2020. Rute J. Macedo de Araújo, José M. González-Méijome (MillionEyes, Revista n° 99, páginas 34-38).

Posterior Chamber Phakic Intraocular Lenses for the Correction of Myopia: Factors Influencing the Postoperative Refraction. (2021). Serra, P., Sánchez Trancón, Á., Torrado Sierra, O., Baptista, A., & Cerpa Manito, S. Optics, 2(4), 292-305.

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7.1.4.2 Books and book chapters

Chapters

Capítulo 22: Tonometría y Biomecánica corneal. In: Temas de Optometría Hospitalaria y Comunitaria. José Manuel González-Méijome, Jorge Manuel Jorge, Paulo Fernandes, António Queirós, Alejandro Cerviño Expósito. 2021. ISBN: 978-84-09-28118-3. Sociedad Española de Optometría.

7.1.4.3 Conference Proceedings with Pier Review appearing in the ISI Database

Accommodative Lag by Open-field Autorefractor and Hartmann-Shack Aberrometer, Jessica Gomes, Kishor Sapkota, Patrícia Nogueira and Sandra Franco, EPJ Web Conf., 255 (2021) 12002, DOI: https://doi.org/10.1051/epjconf/202125512002
Crystalline lens curvature and thickness obtained with a slit-scanning system: preliminary results, Jessica Gomes and Sandra Franco. Proc. SPIE 11919, Translational Biophotonics: Diagnostics and Therapeutics, 119191I (7 December 2021); https://doi.org/10.1117/12.2614868

7.1.5 Conference Presentations

7.1.5.1 Invited talks delivered at Conferences (International/National)

International

González-Méijome JM. Visual electrophisiology in myopia and applications for treatments evaluation. Instituto de Oftalmobiologia Apliada (IOBA). Universidad de Valladolid. November 24th, 2021 (on-line participation).

González-Méijome JM. Visual electrophisiology in myopia and applications for treatments evaluation. Jornadas de Miopía - OptoAcademy. Madrid. November 20th, 2021 (on-line participation).

González-Méijome JM. Progresión de la Miopía y su Control: Por qué, Quién, Cuándo, Qué, Cómo?. Jornadas de Optometria Delegación Regional del CNOO de Canarias. Canarias. October 23rd, 2021 (on-line participation).

González-Méijome JM. Lentes contacto blandas en control de miopía. College clínica oftalológica de Antioquia. Medellín-Colombia. August 14th, 2021 (on-line participation).

González-Méijome JM, Piñero D, Villa-Collar C. Journal of Optometry: DE LA IDEA A LA PUBLICACIÓN. Conceptos básicos para el desarrollo de una publicación científica. Congresso Internacional de Optometria, Contactologia y Óptica Oftálmica. May 22th, 2021.

González-Méijome JM. Control de la Miopía con MiSight® 1 day, lentes de contacto desechables diarias. Congresso Internacionalde Optometria, Contactologia y Óptica Oftálmica. May 2021 (on-line participation).

Madalena Lira. Importância das soluções de manutenção e a sua relação com as lentes de contacto// Importancia de las soluciones de mantenimiento y su relación con las lentes de contacto. II Jornada Anual de Contactología Alcon - General Optica / Mais Optica. Alcon Experience Center, Barcelona, ES. 6 e 7 de outubro de 2021.

Changes in peripheral ocular aberrations with accommodation: pilot study, Franco, Sandra, EOSAM 2021 (Rome, Italy).

National

Evolução da Adaptação de Lentes de Contacto entre 2007 e 2020. Rute J. Macedo-de-Araújo. 16ª Jornada Científico-Técnica de Contactologia (CONTACTUM2021).

Lentes Esclerais. Rute J. Macedo de Araújo. OptoVisionarium (14 janeiro 2021 – palestra online).

7.1.5.2 Contributed talks delivered at Conferences (International/National)

International

Crystalline Lens Curvature and Thickness obtained with a Slit-Scanning System: Preliminary Results Jessica Gomes; Sandra Franco; Universidade do Minho, Braga, Portugal. European Conferences on Biomedical Optics (June 22, 2021)

António Queirós, Jéssica Costa Leitão, Joana Silva, Ana Filipa Pereira Mota, Ana Amorim de Sousa, Paulo Fernandes, José González-Méijome. ORTOQUERATOLOGÍA NOCTURNA EN LA RESPUESTA ACOMODATIVA EN SUJETOS MIOPES, 26º Congreso Internacional de Optometría, Contactología y Óptica Oftálmica, OPTOMonline, Madrid, 2021

António Queirós, Jéssica Costa Leitão, Joana Silva, Ana Filipa Pereira Mota, Ana Amorim de Sousa, Paulo Fernandes, José González-Méijome. CAMBIOS EN LOS POTENCIALES EVOCADOS VISUALES UTILIZANDO ORTOQUERATOLOGÍA EN SUJETOS MIOPES - ESTUDIO PILOTO. 26º Congreso Internacional de Optometría, Contactología y Óptica Oftálmica, OPTOMonline, Madrid, 2021

Mazuze A, Vilanculos JA, Nhambide Bh, Abdulale JE, Queirós A, González-Méijome JM. PARÁMETROS OCULARES Y CIRUGÍA DE CATARATAS EN MOZAMBIQUE. 26º Congreso Internacional de Optometría, Contactología y Óptica Oftálmica, OPTOMonline, Madrid, 2021

Gomes, Jessica; Sapkota, Kishor; Nogueira, Patrícia; Franco, Sandra. Accommodative lag by open-field autorefraction and Hartmann-Shack aberrometer. EOSAM 2021 (Rome, Italy).

Jorge Jorge, Cristiana Gonçalves; Estado refractivo de los niño de una población Portuguesa que ingresan en la escuela y su evolución en los 2 primeros años; OPTOM- online - 26º congreso de Optometria, Contactologia y Óptica Oftálmica; 8-28 mayo 2021

Jorge Jorge, Cristiana Gonçalves; Uso de la agudeza visual como factor coadyuvante para la clasificación de las ametropías.; OPTOM- online - 26º congreso de Optometria, Contactologia y Óptica Oftálmica; 8-28 mayo 2021

National

Cuidados Visuais para Ver Melhor o Futuro. Rute J. Macedo-de-Araújo, António Queirós Pereira, Ana Amorim de Sousa, Paulo Fernandes, Sofia C. Peixoto-de-Matos. Palestra Online de divulgação científica no âmbito do Dia Mundial da Visão (outubro 2021)

Fernandes P. Condições de Acesso aos Planos de Estudos em Optometria e Ciências da Visão. XVI Conferências Abertas de Optometria (CAOs). 6-7 novembro 2021 (on-line participation).

7.1.6 National/International Patents

7.1.7 SPIN-OFFS, START-UPS

7.1.8 Supervision of Research Students

7.1.8.1 PhD projects completed in 2021

Author	Supervisor	Title	Host institution/Program	Scholarship reference	Starting Date

7.1.8.2 PhD projects in progress in 2021

Author	Supervisor	Title	Host institution/Program	Scholarship reference	Starting Date
Alshaarawi M. A. Salem	Sandra Franco/ António Baptista	The effect of near vision tasks in the visual system: university students	PhD Optometry and Vision Sciences	Own	01/12/2018
Ana Isabel Carvalho Sousa	José M. González Méijome e António Queirós	Adaptive and Selective Optical Setup for Visual Stimulation: Proof of Concept, Experimental Setup and Validation	PhD Optometry and Vision Sciences	SFRH/BD/136684/2018	01/10/2018
Andreia Esteves Gomes	Sérgio M.C. Nascimento e João M.M Linhares	Tuning illumination and colored optical filters for optimal viewing of human skin	PhD Optometry and Vision Sciences	SFRH/BD/147336/2019	01/05/2020
Dora Nazaré Marques	Sérgio M.C. Nascimento e João M.M Linhares	Environmental spectral statistics and brain plasticity – testing hypotheses about the mysterious vision of X-linked forms of colour vision deficiencies (2020.05785.BD)	PhD Optometry and Vision Sciences	2020.05785.BD	01/05/2021
Eduardo Ínsua Pereira	Madalena Lira e Paula Sampaio	Evaluation of cytotoxic potential and inflammatory response induced by contact lenses	PhD Optometry and Vision Sciences	Own	01/10/2019
Francesco Viviano	José M. González Méijome e Rute J. Macedo-de-Araújo		PhD Optometry and Vision Sciences	Own	
Jessica Rafaela Moreira Gomes	Sandra Maria Braga Franco	Real-time measurement of the ocular and internal wavefront aberrations of the eye during accommodation (2020.08737.BD9	PhD Optometry and Vision Sciences	2020.08737.BD	02/05/2021
José Alexandre Rodrigues Monteiro	João M.M Linhares e Sérgio M.C. Nascimento	Neural networks applied to the preservation and restoration of artistic paintings.	PhD Optometry and Vision Sciences	Own	
Lina María Rodríguez Cely	José M. González Méijome e António Queirós	Corneal and refractive parameters with impact in contact lens fitting in Colombia and Portugal	PhD Optometry and Vision Sciences	Own	
Luis Proença Oliveira	Jorge Jorge		PhD Optometry and Vision Sciences	Own	

Pedro Tiago Maia dos de Reis Jesus	Jorge Jorge	O Efeito da compensação das disfunções acomodativa/vergenciais na progressão da miopia	PhD Optometry and Vision Sciences	Own	27/05/2020
Rita Maria Martins Alves	Fernanda Cássio, Madalena Lira e Ana Vera Machado	Contact lens materials: An ecosystem issue and a contribution to a circular economy	Doutoramento em Biologia Molecular e ambiental	2021.07082.BD	01/02/2018
Salomé Aurora Parente Pereira.	Paulo Fernandes	Objective Eye Care Measurements Obtainment with Eyetracker and their Influence on Ophthalmic Lens Adaptation	PhD Optometry and Vision Sciences	Own	01/10/2021
Timothy Albert	José M. González Méijome e Rute J. Macedo-de-Araújo		PhD Optometry and Vision Sciences	Own	
Vera Lúcia Alves Carneiro	José M. González Méijome	Advocacy for Promotion and Integration of Refractive Error Services into National Health Services	PhD Optometry and Vision Sciences	Own	

7.1.8.3 MSc projects completed in 2021

Author	Supervisor	Title	Host institution/Program
Avelino Mazuze	José M. González Méijome e Rute J. Macedo-de-Araújo	Impact of soft contact lenses for digital devices on visual performance, tear film, accommodative response and dehydration in young adult subjects: a pilot study	ECUM
Rui Miguel Rodrigues Couto	António Queirós e José M. González Méijome	Avaliação de alterações corneais em pacientes com queratocone	ECUM
Gisela Ferreira Carlos Hauela	António Queirós e Alberto Diaz-Rey	Revisão dos Tratamento da retinopatia do prematuro em África	ECUM
Cécilia Ferreira Marçal	Sandra M.B. Franco e João M.M. Linhares	Avaliação da resposta acomodativa para iluminação de diferentes comprimentos de onda	ECUM
Marta Isabel Ferreira Martins	João M.M. Linhares	O efeito da capsulotomia no erro refrativo e na pressão intraocular	ECUM
Bruna Cristina Vieira Macedo	Madalena Lira e Sandra Franco	Avaliação das alterações dinâmicas do filme lacrimal	ECUM
Carolina Abreu	Sandra Franco	Efeito do diâmetro pupilar na acomodação	ECUM
Cécilia Marçal	Sandra Franco/João Linhares	Avaliação da resposta acomodativa para iluminação de diferentes comprimentos de onda.	ECUM
Juliana Alves	Sandra Franco	Curvas de Disparidade de Fixação numa população Clínica	ECUM
Lídia Nunes	Sandra Franco	Disfunções acomodativas: definição, diagnóstico e tratamento	ECUM
Beatriz Andrade Oliveira Faria Moreira	Jorge Jorge	Prevalência do erro refrativo numa população clínica e a sua progressão num período de 20 anos	ECUM

7.2. Physics of quantum materials and bionanostructures

7.2.1. Researchers

Principal investigator	Paulo José Gomes Coutinho
Members (31/12/2021)	**Effective members** Ana Rita Oliveira Rodrigues (until July) Anabela Gomes Rolo Bernardo Gonçalves Almeida Bruno António Campos Amorim Diogo Alberto Rocha Lopes Eduardo Jorge Nunes Pereira (until October) Elisabete Maria dos Santos Castanheira Coutinho Etelvina de Matos Gomes Gaspar José Brandão Queirós Azevedo Machado Gueorgui Vitalievitch Smirnov Irene Estevez Caride (until December) Pedro Santos Hall Agorreta Alpuim Joel Nuno Pinto Borges Jorge Manuel da Silva Figueiredo José Carlos Viana Gomes Luís Manuel Gomes Vieira Maria de Fátima Guimarães Cerqueira Maria Elisabete da Cunha Dias Real Oliveira (Until June) Mário Rui da Cunha Pereira Marlene Susana Dionísio Lúcio Michael Scott Belsley Mikhail Igorevich Vasilevskiy Nuno Miguel Machado Reis Peres Paulo José Gomes Coutinho Peter Michael Schellenberg (until November) Ricardo Pedro Lopes Martins de Mendes Ribeiro Rosa Maria Ferreira Batista Rui Miguel Soares Pereira Sofia Oliveira Lopes Stephane Louis Clain Yuliy Bludov **Collaborators with PhD – staff members** Jorge António Silva Mendes Júlia Maria Simões Dias Barata de Tovar Ayres de Campos Teresa Maria Santos Ribeiro Viseu **Other collaborators with PhD** Ana Rita Oliveira Rodrigues (since July) Ana Pedro Lemos Paião

	Filipe André Peixoto Oliveira Jaime Eduardo Vieira Silva Moutinho Santos Maria Elisabete da Cunha Dias Real Oliveira (since June) Peter Michael Schellenberg (since november) **PhD students (affiliated to CF-UM-UP-Minho and supervised by Centre researchers)** Anita Camillini Beatriz Dias Cardoso Bruna Machado da Silva Bruno Rodrigues Pacheco e Murta Celso Joel Oliveira Ferreira Eduarda Barbosa Fernandes Francisca Marçal Queiroz Pinheiro Guedes Gonçalo Filipe Santos Catarina Irina Soraia Rainho Rio James Caleb Peters João Miguel Peixoto Oliveira João Pedro dos Santos Pires José Diogo Guimarães Maria João Fernandes Faria Marta Sofia Vilela Barreira Teixeira Maurício Quintela Nelssom Cunha Patrícia Alexandra Pereira da Silva Patrícia Daniela Cabral da Silva Rafael Wagner Raquel Gaudência Dias Andrade Ricardo Jorge Cunha Fernandes Sérgio Rafael da Silva Veloso Telma Campos Domingues Tiago Alves Queirós Viviana Lima de Sousa Yelko del Castillo Hernández

7.2.2 Brief description of the scientific work carried out within the Research Line in 2021

Considering graphene and 2D-materials, most of the work done in 2021 is related to the excitonic properties of two-dimensional materials and to the plasmonic properties of graphene. Diffraction of electromagnetic wave on the periodic structure, which is composed of the graphene monolayer (cladded between two hBN layers), deposited on top of the metal film, which in its turn is periodically patterned with an array of parallel slits, was investigated theoretically. The theroretically predicted results reveal good correspondence with experimental ones, obtained by group of ICFO (Barcelona).

The 2D Materials and Devices group (2DMD) research activity focused on bringing graphene and 2D materials from a scientific curiosity to real-world applications addressing commercial and societal challenges. Graphene devices were designed and fabricated at the wafer-scale for bio-applications, with an emphasis on the detection of biomarkers for the hemorrhagic transformation of ischemic stroke, in DNA sequence determination for certifying the authenticity of Douro wine, in the detection of hepatitis C virus, and the detection of dopamine (a neurotransmitter in brain activity). The research on environmentally-friendly graphene inks and single-photon emitters based on defects in hBN was continued.

The development of the software 'berry', for the calculation of Berry connections and non-linear optical properties, were continued. DFT calculations were also continued for TEM results interpretation.
Modelling of charge and energy transfer processes in low-dimensional semiconductors and photosynthetic biosystems was carried out, as well as the modelling of plasmonic sensors. A polarimetric LiDAR for materials/objects recognition was developed.
The improvement of the second harmonic microscope by implementing a prism based dispersion compensating system was carried out. A cross-phase modulation experiment to explore the dispersive properties of the third order nonlinear response of graphene was implemented.
Theoretical study of the Electromagnetic Shielding Effectiveness of graphene-based inks and of polymers with added graphene content was carried out. Time-dependent phenomena in electrolytic cells with graphene electrodes where ion adsorption occurs were studied. The exact numerical study of the Hubbard model in systems with up to 14 sites and several 1D and 2D geometries was performed.
Magnetic and magnetic/plasmonic bionanosystems for multimodal cancer therapy were improved regarding biocompatibility, triggered drug release and synergystic application of hyperthermia. Specifically, magnetoliposomes based on calcium/magnesium ferrites (portuguese patent granted; international patent pending) and magnetic/plasmonic nanoparticles (both spherical and with shape anisotropy) were prepared, characterized and tested as drug nanocarriers. Temperature- and pH-responsive lipid-based bionanosystems were developed. Novel magnetolipogels combining peptide-based hydrogels, liposomes and magnetic/plasmonic nanoparticles were developed. Optimized nanocarriers for derivatives of plant extracts were obtained, focusing the application as biopesticides.
Several bionanostructures (cubosomes, liposomes, lipid nanoparticles, polymeric nanofibres, liposomal hydrogels, hybrid polymeric and lipid nanosystems) were developed for therapy purposes as transporters of drugs, bioactives or nucleic acids with fit-by-design approach for more sustainable and rational design, in accordance with EU directives.
New fluorescent probes (squaraines, purine analogues) for biological systems were synthesized and subjected to photophysical characterization, ab initio calculations using Gaussian 09 software and protein blind docking using an adaptation of CB-Dock software.
Nanoplasmonic thin film materials, composed by noble metal nanoparticles (Au, Ag) dispersed in dielectric/semiconductor matrixes (TiO2, CuO, Al2O3, ZnO and AlN), were prepared for application in LSPR gas sensing and biosensing. A high-resolution localized surface plasmon resonance (LSPR) spectroscopy, hardware and software, were tested for sensing assays.
Novel nanostructured multiferroic materials, Can+1MnnO3n+1 films (n=1 and n=infinity) were synthesized and the structural, microstructural and dielectric properties were studied. Multiferroic thin films of (Lu,Sc)FeO3 were prepared and influence of doping and substrate-induced epitaxial deformation on magnetic properties (e.g. antiferromagnetic transition temperature) was studied. New composite magnetic nanofibers based on 2D materials (in particular, CrI3) were prepared by electrospinning and the morphological, chemical and magnetic properties were investigated. The structural, microstructural and spectroscopic properties of ceramics and films of neodymium nickelite were characterized, as well as electrical properties in the region of their metal-insulator transition.
The nanofabrication of hybrid systems composed of cyclic, nano and microstructured chiral dipeptides incorporated in polymer fibers, using the electrospinning technique, was started.
TiO2 nanotubes and graphitic carbon nitride (g-C3N4) nanosheets were produced and coupled with silver and/or copper for photoproduction of hydrogen by visible light, with simultaneous photodegradation of pollutants.
The contributions achieved in computational physics are: the development of new very high order schemes for complex boundary domains or interfaces with application to polymer cooling; a new stabilized method using the MOOD paradigm for the Shallow Water system; an efficient reconstruction methods to preserve the physical discontinuities; an adaptive explicit time scheme to optimize the computational resource in numerical simulation; a new well-balanced scheme for the non-conservative shallow water problem that preserve all the steady-states; the design of an analytical solution for irrigation problem.

7.2.3 Future research summary

Future research will continue the study of the excitonic properties of two-dimensional materials and plasmonic properties of graphene, focusing also the magnetic properties of two-dimensional magnetic materials. The topological properties of the spin waves will be explored and the effect of dilution of the lattice will be considered.

During next year, it is planned to investigate the sensitivity of plasmonic absorbance peak frequencies of graphene hBN based periodically patterned structure to the refractive index of medium, filling the slits in the metal film and create the theoretical basis for using this structure as a plasmonic sensor.
The software 'berry' will continue to be developed, with the objective of calculation of Berry connections and non linear optical properties.
The investigation of excited exciton states in 2D materials will be continued and the modelling of the cross-phase modulation effect in supported and suspended graphene will be performed. Quantum simulations of environment effects on the exciton transport in photosynthetic systems will be carried out.
The 2DMD research group will develop a graphene bioelectronics neural interface for in vivo multimodal brain sensing. It will continue designing and fabricating an on-demand single-photon emitter based on hBN. The group will also develop multiple 2D materials-based inks for electromagnetic shielding, water filtering, and gas sensing applications. Radio-frequency and plasmonic devices based on graphene for THz radiation manipulation will also be studied.
In the field of magnetic/plasmonic bionanosystems, magnetoliposomes, plasmonic liposomes/lipogels and magnetolipogels will be continuously optimized for application in multimodal cancer therapy and theranostics. Magnetic nanorods and innovative plasmonic nanostructures will be explored. Full biocompatibility and spatial/temporal control of (multi)drug release will be achieved. Improved nanoformulations for release of plant extracts or derivatives with enhanced insecticidal activity (patent pending) will be developed.
Innovative strategies will be used for greener production of bionanosystems for therapy and diagnostic purposes, exploring biomimetic and in silico models in conjunction with high-throughput microfluidic assays for refining the design of the therapeutic system. Multifunctional nanosystems containing bioactives and plasmonic structures will be developed to tackle major concerning diseases or to repurpose classical low effective drugs achieving theranostic purposes.
There will be a continuous effort on the research in LSPR thin films to detect chemical stimuli (e.g. LSPR-gas sensing and biosensing) and using other transduction mechanisms, namely mechanical stimuli. Furthermore, enhanced local fields will explored to enhance photosynthetic phenomena.
The development of new micro- and nanostructured materials (films, nanofibers, nanoparticles), with magnetic, ferroelectric and multiferroic properties, for biological, sensor and spintronic applications, will be carried out. Their structural, magnetic, optical and dielectric properties will be investigated. It is intended to perform the dielectric characterization of nanofiber arrays as a function of frequency and temperature by dielectric spectroscopy, and to measure the nanofibers' resistivity. The piezoelectric potential difference generated by nanofiber assemblies (under mechanical forces with different intensities), in a circuit with external charge, will be measured.
A stimulated Raman spectrometer with femtosecond time resolution will be developed. Second harmonic generation and multiphoton induced fluorescence will be used to characterize the structure of cancer cells.
The development of graphitic carbon nitride (g-C3N4) nanosheets coupled with plasmonic nanostructures will be further developed, in order to improve the efficiency of photoproduction of hydrogen with simultaneous photodegradation of pollutants using visible light.
In the field of computational physics, we plan future researches in 2022 in four pillars: the development of very high order compact schemes in time and space (the structural method); a new high-order numerical technology to solve the Schrödinger equation; the optimization of the mesh-less generalized finite difference method and its application to fluid flow; a new solver for the strongly non-linear Richards' equation to solve the irrigation problem.
In several topics, the research carried out this year has not yet been completed and will continue next year.

7.2.4 Publications

7.2.4.1 Regular articles published in ISI/Scopus Journals

A Biophysical Insight of Camptothecin Biodistribution: Towards a Molecular Understanding of Its Pharmacokinetic Issues. A. Almeida, E. Fernandes, B. Sarmento, M. Lúcio. Pharmaceutics 13 (2021) 869; DOI: 10.3390/pharmaceutics13060869 RIS3: Ciências da Vida e Saúde

A MOOD-MUSCL Hybrid Formulation for the Non-conservative Shallow-Water System. J. Figueiredo, S. Clain. Journal of Scientific Computing 88 (1) (2021) 2. DOI: 10.1007/s10915-021-01513-z

A Posteriori Stabilized Sixth Order Finite Volume Scheme with Adaptive Stencil Construction: Basics for the 1D Steady State Hyperbolic Equations. G. J. Machado, S. Clain, R. Loubère. Commun. Appl. Math. Comput. 2021. doi: 10.1007/s42967-021-00140-7

A two-dimensional high-order well-balanced scheme for the shallow water equations with topography and Manning friction. V. Michel-Dansac, C. Berthon, S. Clain, F. Foucher. Computers & Fluids 230 (2021) 105152. DOI: 10.1016/j.compfluid.2021.105152

Amino alcohols from eugenol as potential semisynthetic insecticides: chemical, biological and computational insights. Renato B. Pereira, Nuno F. S. Pinto, Maria José G. Fernandes, Tatiana F. Vieira, Ana Rita O. Rodrigues, David M. Pereira, Sérgio F. Sousa, Elisabete M. S. Castanheira, A. Gil Fortes, M. Sameiro T. Gonçalves, Molecules 26 (2021) 6616; DOI: 10.3390/molecules26216616. RIS3: Sistemas Agroambientais e Alimentação

An a posteriori strategy for adaptive schemes in time for one-dimensional advection-diffusion transport equations. M. T. Malheiro, G. J. Machado, S. Clain. Comput. Math. with Appl. 103 (2021) 65-81; DOI: 10.1016/j.camwa.2021.10.022

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7.2.4.2 Books and book chapters

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Lipid-Based Nanocarriers for co-delivery of Anticancer Drugs and Natural Compounds. E. Fernandes, T. B. Soares, C. M. Lopes, M.E.C.D. Real Oliveira and M. Lúcio, in Part III of "Functional Lipid Nanosystems in Cancer", Chapter 5, edited by M. Lúcio, C. M. Lopes, and M.E. C.D. Real Oliveira (eds), Jenny Stanford Publishing, New York (2021). ISBN: 9781003056997

Temperature Time Series Forecasting in the Optimal Challenges in Irrigation (TO CHAIR). A. M. Gonçalves, C. Costa, M. Costa, S.O. Lopes, R.M.S. Pereira. In "Advances in Evolutionary and Deterministic Methods for Design, Optimization and Control in Engineering and Sciences". Computational Methods in Applied Sciences, 55, pp. 423-435, Springer, Cham, 2021.

Irrigation Planning with Fine Meshes. S. O. Lopes, M. F. P. Costa, R. M. S. Pereira, M. T. Malheiro, F.A.C.C. Fontes, in "Advances in Evolutionary and Deterministic Methods for Design, Optimization and Control in Engineering and Sciences". Computational Methods in Applied Sciences, 55, pp. 393-407, Springer, Cham, 2021.

7.2.4.3 Conference Proceedings with Pier Review appearing in the ISI Database

7.2.5 Conference Presentations

7.2.5.1 Invited talks delivered at Conferences (International/National)

International

Out-of-Equilibrium Quantum Transport", Bruno Amorim. Escola Mato Grossense de Física 2021, 3-5 November 2021, IF/UFMT, Cuiabá, MT, Brasil (online, link: https://sites.google.com/fisica.ufmt.br/emf2021/resumos/minicursos#h.8zkibj7dhrac)

Localized Graphene Plasmons in Metallic Slit and Plasmonic Realization of Su-Schrieffer-Heeger model", Yuliy Bludov. International Meet on Nanotechnology (NANOMEET2021), 13-16 September 2021, Vila Nova de Gaia, Portugal.
"Biosensing with Graphene Devices", J. Pedro Alpuim. NanoPT2021 International Online Conference, 16-17 September 2021.

Graphene Products for Micro and Macroelectronics", J. Pedro Alpuim, Jérôme Borme, Agnes Purwidyantri, Sergej Tkachev, Pedro Marques, Andrea Capasso. Graphene Industrial Forum - Online International Conference, 26-27 January 2021.

Artificial Intelligence Assisted Polarimetry for Materials' Discrimination and Characterization", Mikhail Vasilevskiy. III International Conference on Mathematical Modeling in Materials Science of Electronic components (ICM3SEC-2021), Moscow, Russia, 25-26 October 2021.

Surface-plasmon-polariton-assisted diffraction of THz waves on a slit covered with graphene", Mikhail Vasilevskiy. XXV Symposium "Nanophysics and Nanoelectronics", Nizniy Novgorod, Russia, 9-12 March 2021 (online).

"Biosensing with Graphene Devices", J. Pedro Alpuim. NanoPT2021 International Online Conference, 16-17 September 2021.

National

Out-of-Equilibrium Quantum Transport", Bruno Amorim. Quantum Matter | Materials & Concepts Summer School, 8-10 September 2021 (online) & 15-18 September 2021 (Inst. Politécnico de Bragança, Bragança, Portugal)

Implications of Nanoparticles in the Context of Oncology", Elisabete M. S. Castanheira Coutinho. Plenary Talk, III National Meeting of Young Researchers in Oncology, 24 September 2021, Porto, Portugal.

Rational design of nanoformulations with biomedical applications", M. Lúcio. Thematic seminar presented in the Medicine Technologies School, 3 December 2021, Faculty of Pharmacy of University of Coimbra, Coimbra, Portugal.

7.2.5.2 Contributed talks delivered at Conferences (International/National)

International

Quantum dot PL emission control through a nearby graphene layer. César Rui Bernardo, Diogo Cunha, Fátima Cerqueira, Michael Belsley, Peter Schellenberg, Mikhail Vasilevskiy. European Optical Society Annual Meeting (EOSAM) 2021, 13-17 September 2021, Rome, Italy.

Supramolecular magnetolipogels: a co-assembly strategy for on-demand drug release. Sérgio R. S. Veloso, Miguel A. Correa-Duarte, Paula M. T. Ferreira, Elisabete M. S. Castanheira. Meeting on Advances and Challenges in Nanomedicine 2021, Online, 12 April 2021.

The interplay of nanocomposites co-assembly with peptide-based gels as a strategy towards on-demand drug release. Sérgio R. S. Veloso, Miguel A. Correa-Duarte, Paula M. T. Ferreira, Elisabete M. S. Castanheira. NanoPT2021 Online Conference, 16–17 Sept. 2021.

Magnetic and Dielectric Properties of Ruddlesden–Popper Ca3Mn2O7 thin films prepared by Pulsed Laser Ablation. B. Silva, J. Oliveira, T. Rebelo, P. Rocha-Rodrigues, N. Lekshmi, A. Lopes, J. Araújo, L. Francis, B. Almeida. 6th Smart Materials & Surfaces Conference (SMS 2021), Milan, Italy, 20-22 October 2021.

Growth of (CaO)(CaMnO3)n Thin Films by Pulsed Laser Deposition. B. M. Silva, J. Oliveira, T. Rebelo, P. Rocha-Rodrigues, P. N. Lekshmi, A. M. L. Lopes, J. P. Araújo, L. Francis, B. Almeida. ISAF-ISIF-PFM 2021 Conference (combining the IEEE International Symposium on Applications of Ferroelectric (ISAF), International Symposium on Integrated Functionalities (ISIF) and Piezoresponse Force Microscopy Workshop (PFM)), 16-21 May 2021.

Magnetic Nano/Microfibres With Highly Oriented van der Waals CrI3 Inclusions by Electrospinning. V. B. Isfahani, J. F. H. Belo da Silva, L. Boddapati, A. G. Rolo, R. M. F. Baptista, F. L. Deepak, J. P. Araújo, E. de Matos Gomes, B. G. Almeida. INTERMAG 2021 - IEEE International Magnetics Conference, 26-30 April 2021.

Gd5(Si,Ge)4 nanoparticles produced by pulsed laser deposition. V.M. Andrade, N.R. Checca, J.H. Belo, A. L. Rossi, F. Garcia, B.G. Almeida, M. S. Reis, A.M. Pereira, J.P. Araújo. INTERMAG 2021 - IEEE International Magnetics Conference, 26-30 April 2021.

Growth of Ruddlesden–Popper (CaO)(CaMnO3)n Thin Films by Laser Ablation Deposition. B. M. Silva, J. Oliveira, T. Rebelo, P. R. Rodrigues, P. Lekshmi, A.L. Lopes, J. P. Araújo, F. L. Deepak, B. G. Almeida, INTERMAG 2021 - IEEE International Magnetics Conference, 26-30 April 2021.

Sensitivity analysis of a parametric optimal control problem applied to daily irrigation. Ana P. Lemos-Paião, Dynamic Control and Optimization (DCO 2021), Aveiro, Portugal. 3-5 February, 2021.

Irrigation optimal control problem with a quadruple sectioned soil. Ana P. Lemos-Paião, The Cape Verde International Days on Mathematics 2021 (CVIM'2021), Praia, Cape Verde, 6-10 September, 2021.

Multiplexed lab-on-a-chip platform for DNA and protein analysis using graphene transistors. P. Alpuim, A. Purwidyantri, P. D. Cabral, T. Domingues, A. Ipatov, J. Borme, M. Prado. Biosensors 2021 – Online - 31st Anniversary World Conference on Biosensors, 26-29 July 2021.

Biological matrix effects in graphene-based biosensors. Patrícia D. Cabral, M. Martins, I. Colmiais, J. Borme, P. Alpuim, E. Fernandes. Graphene 2021, 26-29 October 2021, Grenoble, France.

Mini sensor based on graphene transistor for wine authenticity tracing by DNA detection. Agnes Purwidyantri, Sarah Azinheiro, Carla Teixeira, Andrey Ipatov, Telma Domingues, Marco Martins, Jérôme Borme, Pedro Alpuim, Marta Prado. NanoPT2021, 16-17 September 2021, online conference.

Ultra-transparent broadband terahertz polarizers by nanoimprint lithography. Alexandre Chícharo, Tatiana G. Rappoport, Chun-Da Liao, Jérôme Borme, Nuno M. R. Peres, Pedro Alpuim. NanoPT2021, 16-17 September 2021, online conference.

Liquid phase exfoliated graphene nanosheets as laminates for water purification. Siva Sankar Nemala, J. Fernandes, J. Rodrigues, P. Alpuim, A. Capasso. NanoPT2021, 16-17 September 2021, online conference.

Attomolar label-free dopamine detection with aptamer functionalized graphene field-effect transistors. Mafalda Abrantes, P. D. Cabral, T. Domingues, J. Borme, L. Jacinto, P. Alpuim. NanoPT2021, 16-17 September 2021, online conference

National

Non-smooth optimal control applied to irrigation: analytical analysis and illustrative results. Ana P. Lemos-Paião, Portuguese Meeting on Optimal Control (EPCO 2021), 28-29 June 2021, Lisboa, Portugal.

Multifunctional Fe-Au nanostructures for biomedical applications, Sara Freitas, J.H. Belo, C.T. Sousa, R.C. Magalhães, H. Crespo, M. Canhota, M.P. Almeida, E. Pereira, B. Almeida, B.M. Silva, J.P. Araújo, IJUP 2021 - 14º Encontro de Investigação Jovem, Universidade do Porto, 5-7 Maio 2021.

Dispositivos de grafeno para a micro e macroelectrónica, P. Alpuim, Seminário do Núcleo de Estudantes de Física e Engenharia Física da Universidade do Minho, ENEF online, 28 de Março de 2021.

E se o futuro for (com) grafeno?, Pedro Alpuim, Jornadas de Engenharia Electrónica Industrial e Computadores 2021, 26 de Fevereiro 2021, online.

7.2.6 National/International Patents

National

Nanossistema magnético e método para produzir o nanossistema". Ana Rita Oliveira Rodrigues, Daniela Sofia Marques Pereira, Beatriz Dias Cardoso, Elisabete Maria dos Santos Castanheira Coutinho, Paulo José Gomes Coutinho. in I.N.P.I., Portuguese Patent N.º 115474 B, aproved in 27/04/2021, published in "Boletim de Propriedade Industrial" N° 2021/04/30.

International

7.2.7 Spin Off

7.2.8 Supervision of Research Students

7.2.8.1 PhD projects completed in 2021

Author	Supervisor	Title	Host institution/Program	Scholarship reference
Andreia Marina de Sousa Almeida	Bruno Sarmento (i3S), Marlene Lúcio, S. Schwartz (CIBBIM, Barcelona)	Mucoadhesive camptothecin polymeric micelles as nanodelivery systems for oral chemotherapy to treat colorectal cancer.	PhD Program in Biomedical Sciences, ICBAS, Univ. Porto Concluded: July 2021	SFRH/BD/118721/2016
Balaji Sompalle	Pedro Alpuim	Fabrication of a photodetector based on 2D vertical Van der Waals heterostructures	Doctoral Program in Physics (MAP-Fis), ECUM	INL

7.2.8.2 PhD projects in progress in 2021

Author	Supervisor	Title	Host institution/Program	Scholarship reference	starting date
Anita Camillini	Ernesto Galvão (INL), Michael Belsley	Architectures for scalable quantum photonic computing	Doctoral Program in Physics (MAP-Fis)		

Beatriz Dias Cardoso	Elisabete M.S. Castanheira Coutinho, Vanessa Cardoso, S.Lanceros-Méndez	Microfluidic evaluation of drug-loaded magnetoliposomes as multifunctional platforms for advanced cell therapies (SFRH/BD/141936/2018)	PhD Program in Materials Engineering	SFRH/BD/141936/2018	
Bruna Machado da Silva	Bernardo Almeida, João P. Araújo (FCUP), Armandina Lopes (IFIMUP)	Naturally Layered Perovskyte Heterostructures	Doctoral Program in Physics (MAP-Fis)	2021.07277.BD	
Bruno Rodrigues Pacheco e Murta	Joaquín Rossier (INL), Nuno Peres	Quantum Many-Body Ground States via Digital Quantum Simulation	Doctoral Program in Physics (MAP-Fis)	2020.08444.BD	
Celso Joel Oliveira Ferreira	Bruno Silva (INL), Cláudia Botelho (CEB), M. Elisabete Oliveira	Microfluidics for size-controlled cationic liposome-DNA complexes: going beyond the universal transfection curve	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/149199/2019	
Eduarda Barbosa Fernandes	Marlene Lúcio, Vanessa Cardoso, S. Lanceros-Méndez	BIOMYSKIN – Biomimicry profiling supporting drug discovery for topical applications (SFRH/BD/147938/2019)	PhD Program in Materials Engineering	SFRH/BD/147938/2019	
Francisca Marçal Pinheiro Guedes	Mário Rui Pereira, Susana Costa (DQ), Martin Lopez Garcia (INL)	Novel quantum materials inspired by natural photonic photosynthetic structures	PhD in Applied Chemistry		
Gonçalo Filipe Santos Catarina	Nuno Peres, Joaquín Rossier (INL)	Emergent correlated electronic phases in van der Waals heterostructures (SFRH/BD/138806/2018)	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/138806/2018	
Irina Soraia Rainho Rio	Paulo J. G. Coutinho, Elisabete M. S. Castanheira Coutinho, Fátima Baltazar (ICVS)	Lipid nanocarriers containing magnetic / gold nanoparticles coated with mesoporous silica for application in SCC skin cancer therapy (2020.04431.BD)	PhD Program in Materials Engineering	2020.04431.BD	
James Caleb Peters	João Pedro Santos Hall Agorreta Alpuim	Correlation of transport and structural properties of Graphene and Bismuth Telluride as a function CVD growth parameters	Doctoral Program in Physics (MAP-Fis)		
João Miguel Peixoto Oliveira	Bernardo Almeida, Leonard Francis (INL)	Multiferroic bilayer composites for coupled magnetic-electric-optical functionalization	Doctoral Program in Physics (MAP-Fis)	2021.08158.BD	
João Pedro dos Santos Pires	João Parente Lopes (CF-UM-UP, FCUP); Bruno Amorim	Non-Equilibrium Quantum Transport and Ultrafast Dynamics at the Mesoscopic Scale (PD/BD/142774/2018)	Doctoral Program in Physics (MAP-Fis)	PD/BD/142774/2018	
José Diogo Guimarães	Mikhail Vasilevskiy, Luís Barbosa (C. Algoritmi)	Investigation of quantum effects on energy and charge transport in photosynthetic systems using quantum simulations (UI/BD/151137/2021)	Doctoral Program in Physics (MAP-Fis)	UI/BD/151137/2021	
Maria João Fernandes Faria	Marlene Lúcio, M. Elisabete Oliveira, G. Carracedo (Univ. Complutense de Madrid)	MeYeDEAR – Monoolein-based EYE DElivery systems for Age-related Retinopathies	PhD Optometry and Vision Sciences	2020.06561.BD	
Marta Sofia Vilela Barreira Teixeira	Alice Carvalho (CQUM), Elisabete M. S. Castanheira Coutinho	Development of a drug carrier nanosystem for a new anticancer drug and optimization of the new drug (2020.04975.BD)	Doctoral Program in Chemistry, ECUM	2020.04975.BD	
Maurício Quintela	Nuno Peres	Excitons in two dimensional materials and van der Waals Heterostructures	Doctoral Program in Physics (MAP-Fis)	INL	

Nelssom Cunha	José Gomes, Luis Rebouta	Developments of Alternative Methods for the Measurements of Beam Quality in the Light Detection and Ranging -LIDAR	Doctoral Program in Physics (MAP-Fis)		
Patrícia Alexandra Pereira da Silva	Ana Paula Sampaio (CBMA), Joel Borges	Development of nanocomposite ZnO thin films with antibiofilm and antimicrobial properties to prevent pathogens' transmission	Doctoral Program in Molecular and Environmental Biology, ECUM	2020.08235.BD	
Patrícia Daniela da Silva	J. Pedro Alpuim	Immuno-field-effect transistor platforms based on 2D materials for early detection of biomarkers of ischemic stroke	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/128579/2017	
Rafael Wagner	Ernesto Galvao (INL), Mikhail Vasilevskiy	Coherence and contextuality as quantum resources	Doctoral Program in Physics (MAP-Fis)	INL	
Raquel Gaudência Dias Andrade	Elisabete M. S. Castanheira Coutinho, M. Côrte-Real (CBMA), Lígia Reodrigues (CEB)	Functionalized magnetoliposomes for enhanced anticancer activity of lactoferrin against triple negative breast cancer cells	PhD Program in Materials Engineering	2020.05781.BD	
Ricardo Jorge Cunha Fernandes	Paulo Coutinho, Madalena Alves (CEB), Luciana Pereira (CEB)	Photocatalytic degradation of PFAS under visible light: development of nanomaterials as novel photocatalysts and process scale-up	PhD Program in Materials Engineering	2021.08418.BD	
Sérgio Rafael da Silva Veloso	Elisabete Castanheira Coutinho,P.M.T. Ferreira (CQUM), M. Correa-Duarte (U.Vigo)	Development of multifunctional supramolecular magnetogels for multimodal cancer therapy	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/144017/2019	
Telma Campos Domingues	J. Pedro Alpuim, Jérôme Borme (INL), Bruno Costa (ICVS)	Multiplex detection of circulating tumor DNA using graphene electrolyte-gate field-effect transistors (SFRH/BD/08181/2020)	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/08181/2020	
Tiago Alves Queirós	J. Pedro Alpuim, Jana Nieder (INL)	Single Photons on-Demand from a 2D Materials Heterostructure (SFRH/BD/150646/2020)	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/150646/2020	
Viviana Lima de Sousa	J. Pedro Alpuim, Yuri Kol'enko (INL)	Unconventional Thermoelectrics Based on Self-Organized Nanocrystal Superlattices (SFRH/BD/143750/2019)	PhD Program in Materials Engineering	BD/143750/2019	
Yelko del Castillo Hernández	Joaquín Fernández Rossier / Nuno Miguel Reis Peres	Single spin resonance magnetometry with scanning tunneling microscopy	Doctoral Program in Physics (MAP-Fis)		

7.2.8.3 MSc projects completed in 2021

Author	**Supervisor**	**Title**	**Host institution/Program**
Ana Sofia Pêra de Sousa	Alice Dias (CQUM), Elisabete M.S. Castanheira Coutinho	Novos Análogos de Purina como Candidatos a Sondas Fluorescentes para Sistemas Biológicos	MSc. in Techniques for Characterization and Chemical Analysis, ECUM
André Vieira Ferreira Fernandes	Paulo J. G. Coutinho, A. Rita O. Rodrigues	Magnetolipossomas baseados em nanopartículas magnéticas de tipo flor para aplicação em terapia dual do cancro	MSc. in Biophysics and Bionanosystems, ECUM
Ânia Barata Micaelo	Jana Nieder (INL), M. Elisabete Oliveira	Bionanostructures for intracellular temperature sensing during photothermal cancer treatment	MSc. in Biophysics and Bionanosystems, INL/ECUM
Armando Martins da Nova Dias	Lorena Diéguez (INL), M. Elisabete Oliveira	Fabrication of plasmonic nanosubstrate for SERS-based nucleic acid detection	MSc. in Biophysics and Bionanosystems, INL/ECUM

Beatriz Carvalho Ribeiro	Elisabete M. S. Castanheira Coutinho, A. Rita O. Rodrigues	Magnetolipossomas funcionalizados para aumento do potencial terapêutico de fármacos antitumorais	MSc. in Biophysics and Bionanosystems, ECUM
Diogo da Silva Gomes	Bruno F. Silva (INL), M. Elisabete Oliveira	Microfluidics as nanoassemblers of soft self-assembled nanocarriers for drug delivery	MSc. in Biophysics and Bionanosystems, INL/ECUM
Diogo Filipe Pinto Cunha	Mikhail Vasilevskiy	Hot electrons and nonlinear optical properties in 2D materials	MSc. in Physics, ECUM
Inês Catarina Pedro Bártolo	Elisabete M. S. Castanheira Coutinho, Mariana Cerqueira (I3Bs)	Particle-based system for Keratinocyte Growth Factor release in skin models	MSc. in Biophysics and Bionanosystems, I3Bs/ECUM
João Carlos Henriques	Nuno Peres	Excitons in two-dimensional materials	MSc in Physics, ECUM
João Carlos Roberto de Freitas	Jana Nieder (INL), M. Elisabete Oliveira	Photonic Nearfield Effects Applied to Real-Time Biosensing Super Resolution Bioimaging	MSc. in Biophysics and Bionanosystems, INL/ECUM
João Henrique de Castro Fernandes	Andrea Capasso (INL), Pedro Alpuim	Large-scale, controlled growth of two-dimensional materials by chemical vapor deposition	MSc. in Engineering Physics, ECUM/EEUM/INL
Mafalda Francisca Ramoa da Costa Alves	Ernesto Galvao (INL), Mikhail Vasilevskiy	Ansätze for Noisy Variational Quantum Eigensolvers	MSc. in Engineering Physics, ECUM/EEUM/INL
Micaela Tavares Oliveira	Elisabete M. S. Castanheira Coutinho; Alar Ainla (INL)	Electrochemical pH monitoring in cell culture systems	MSc. in Biophysics and Bionanosystems, INL/ECUM
Miguel Rocha	Bernardo Almeida, Kevin Rodrigues (CENTI), Raul Falcão (Continental)	Development and integration of wireless temperature textile sensors for rubber composites	Integrated Master in Materials Engineering, EEUM
Rafael André Valente Lemos	J. Miguel Oliveira (I3Bs), Paulo J. G. Coutinho	Carbon nanotubes-reinforced cell-derived matrix-silk fibroin hierarchical scaffolds for bone tissue engineering applications	MSc. in Biophysics and Bionanosystems, ECUM
Tiago da Silva Alves de Nogueira Simões	Nuno Araújo (FCUL), Mikhail Vasilevskiy	Kirigami at the microscale	MSc. in Physics, ECUM
Tiago Miguel Pereira Rebelo	Bernardo Almeida, Leonard Francis (INL)	Ferroelectric thin film nanostructures by laser ablation	MSc. in Physics, ECUM

7.3 Functional and smart materials and surfaces for advanced applications

7.3.1 Researchers

Principal investigator	Carlos Tavares
Members (31-12-2021)	**<u>Effective members</u>** António Mário Lourenço da Fonseca Almeida Armando José Barros Ferreira Cacilda Maria Lima de Moura Carlos José de Macedo Tavares Clarisse Marta Oliveira Ribeiro Claudia Jesus Ribeiro Lopes Carlos Miguel Silva Costa Francisco José Machado de Macedo Joaquim Alexandre dos Santos Almeida de Oliveira Carneiro José Filipe Vilela Vaz José Pedro Basto da Silva Luís António Carvalho Gachineiro da Cunha Luís Silvino Alves Marques Luís Manuel Fernandes Rebouta Manuel Filipe Pereira da Cunha Martins Costa Maria de Jesus Matos Gomes Mário António Caixeiro de Castro Pereira Marta Maria Duarte Ramos Nuno Miguel Germano Parreira (until november) Pedro Libânio Abreu Martins Raquel Diana Carneiro Alves Sandra Mariana Silva Marques Sandra Maria Fernandes Carvalho (until February) Senen Lanceros-Mendez Serguey Pyrlin Silvie Oliveira Ribeiro Stanislav Lazarov Ferdov Vasco Manuel Pinto Teixeira Veniero Lenzi **Collaborators with PhD – staff members** Maria Teresa Pitta de Lacerda-Arôso Mário Jorge Dias Zamith Silva Martin Andritschky **Other collaborators with PhD** Cristiana Filipa Almeida Alves (since september) Daniela Maria da Silva Correia Diego Martinez Martinez

	João Pedro Nunes Pereira Marcio Correa (since september) Margarida Maria Macedo Francesko Fernandes Maria José Bastos Pires Lima Pedro Filipe Ribeiro Costa Sandra Maria Fernandes Carvalho (since february) **PhD students (affiliated to CF-UM-UP-Minho and supervised by Centre researchers)** Ana Catarina Branco Lima André Gustavo Silva Macedo António Castro Belgacem Tiss Bruno Alexandre Alves Santos Catarina Isabel da Silva Olveira Daniela Morais Diana Isabela Faria Meira Diogo Coelho da Silva Diogo Emanuel Carvalho Costa Diogo Jorge Martins Ramos Edgar Manuel Neto Carneiro Eduardo José de Sousa Pimetel Elmahdi Amar Estela Marisa Oliveira Carvalho Filipe Costa Correia Hugo Higino de Barros Machado Martins Salazar Iran gomes da Rocha Segundo Isabel Alves Lopes Joana Catarina Dias Moreira Moreira Joana Margarida Fernandes da Silva Ribeiro Joana Marina Silva Queirós João Carlos Pacheco Barbosa João Luís Rodrigues Teixeira João Pedro Cruz Serra Jorge Manuel Pereira Sousa Juliana Filipa Gouveia Marques Liliana Sofia Correia Fernandes Maria Manuela Carvalho Proença Marina do Carmo Alves Marta Adriana Félix Forte Miguel Alexandre Martins Franco Nelson Miguel Macedo da Silva Pereira Rafael dos Santos Pinto Rafaela Marques Meira Ricardo Jorge Brito Gonçalves Pereira Ricardo José da Silva Lima Rita de Magalhães Policia Sérgio Abílio Pereira Gonçalves Teresa Isabel Marques de Almeida Tiago André Rodrigues Marinho

7.3.2 Brief description of the scientific work carried out within the Research Line in 2021

The focus of the overall research done in the strategic line Functional and smart materials and surfaces for advanced applications resided in the development of novel materials based on alloy oxides and nitrides. The inherent studies involved the understanding of the electrical, magnetic, optical and other physical-chemical properties of these materials, having in mind applications in several types of devices, such as sensors, actuators, battery elements, thermoelectrics, solar absorbers, amongst others. Energy considerations are essential in nowadays society and increasingly dependent on mobility and interconnectivity with the need to reduce the environmental impacts related to fossil fuels. The Centre of Physics at the University of Minho is undergoing competitive research in advanced materials for energy. The principal techniques for material development in the form of thin film deposition are magnetron sputtering and laser ablation. A low cost technique by direct inkjet printing has also been recently recurred. Other nano and micro structuring techniques have been employed to functionalize materials. The most important and active examples are: new generation of dental implants with osteocunductive and antibacterial properties; decorative coatings for the automotive industry; separator membranes with high-aspect ratio microstructures for improved battery performance; development of novel capacitive-type sensors; development of transparent thermoelectric thin films for thermal enery harvesting; photocatalytic thin films for self-cleanng applications; high definition screen-printed interdigitated structures for sensors and thin film transistors; hybrid materials for printed and solid-state batteries; reusable polymer hybrid membranes for arsenite and arsenate dual-water remediation; ferroelectric nanoscaled ZrO2 thin films; high-performance self-powered photodetectors; nanocomposite thermoelectrics; thin films used for dry biopotential electrodes; plasmonic thin films for gas sensing devices.

7.3.3 Future research summary

The future research of this strategic line will provide continuity to most of the present activities within running R&D projects. A special focus will be given to development of multi–functional materials for sensors and actuators, energy and biomedical applications with focus on piezoelectric and resistive, magnetoeletric materials deposited by printing technologies, and high energy density batteries, consisting in lithium-ion intercalation electrodes with a separator / electrolyte between them, to allow ionic conduction. Other areas of interest, with potential application in the industry, include R&D in sensors and actuators and battery components, plasmonic nanoparticles for bio-detection, in particular growth and study of novel plasmonic structures with applications in biological and medical science. The future research of this strategic line also comprises the investigation on ferroelectric thin films based on binary oxides, such as ZrO2 and HfO2 for ferroelectric access random access memories (FeRAMs) and energy storage capacitors. In addition, lead-free ferroelectric ceramics and thin films capacitors based on BaCaTiO3-BaZrTiO3 will also be investigated.
In the biomedical applications, the R&D NanoStim Project with the International Partnership of the University of Texas in Austin, will be focused on the development of (nano)sensors based on thin films to be integrated on wearables and used on elderlys' physiotherapy rehabilitation.
LSPR sensors can be optimized to detect chemical, physical or mechanical stimuli, allowing a wide range of fundamental information of on-going processes. Besides LSPR -gas and -biosensors, in the framework of project Nano4bio and 3 PhD thesis, there will be a continuous effort on the research in LSPR thin films using other transduction mechanisms.
Based and expanding the previous works, the main focus is the development of novel approaches and materials to detect, degrade or absorb volatile organic compounds (VOC's) and/or other related environmental hazardous chemicals. The main goal consists in the developing "hybrid" thin-film sensor networks combining in an innovative way two green processes (PVD and Screen Printing) which will allow the development and preparation of a wide variety of different multi-modal sensing systems to control, degrading or absorbing VOC's.
Energetic plasma sources (HIPIMS) will be used to obtain films with higher quality and improved properties. On the other hand, the deposition of protective thin films on 'complex' rubber and cork substrates by magnetron sputtering and Atomic Layer is also a priority in the mainframe of the project 'FORC'. In addition, the Atomic Layer Deposition

technique is currently being explored for the deposition of ternary nitrides in the form of MAX phases (M-ERA.NET project ALD4MAX).
Physical Vapor Deposition at Oblique Angles – PVD-OA and printing technologies are used, either alone or in combination, to produce sensors (reducing cost, improving environmental friendliness and performance) that open new routes of integration of the various types of sensors in advanced applications. Transparent thin film thermoelectrics for thermal energy harvesting are also important in order to render specific devices more self-sustainable and to recover energy wasted as heat.

7.3.4 Publications

7.3.4.1 Regular articles published in ISI/Scopus Journals

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7.3.4.2 Books and book chapters

Books

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7.3.4.3 Conference Proceedings with Pier Review appearing in the ISI Database

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7.3.5 Conference Presentations

7.3.5.1 Invited talks delivered at Conferences (International/National)

International

Senentxu Lanceros-Méndez, "3D Bioprinting: present and future applications; WEBINAR Bioprintign in Health. Impulse of the technology and applicatons of bioprinting in health in the EUROACE region. 16/09/2021, Caceres, Spain

Nikola Perinka, Nelson Castro, Senentxu Lanceros-Mendez, High definition screen-printed interdigitated structures for sensors and thin film transistors, ADVANCED SCREEN PRINTING WORKSHOP, Open Innovation Hub, Valencia, 27/10/2021

S.M. Costa, S. Lanceros-Mendez, Printed and solid-state batteries: materials, challenges and opportunities, UT Austin Portugal 2021 Annual Conference, October 20-21, Invited thematic master class, 6:00 p.m. (LIS) / 12:00 a.m. (AUS).

S. Lanceros-Mendez, Smart biomaterials and organ-on-chip for biomedical applications, Cursos de Verano UPV_EHU - Células Madre + Organoides + Bioprinting 3D _ Gene editing + Biomateriales inteligentes = La medicina personalizada del futuro, 2021-06-07, Bilbao, Spain.

S. Lanceros-Mendez, Materials by design, response by design: active and multifunctional materials 28-29 June 2021, SYMPOSIUM ON ENGINEERING PHYSICS, Porto, Portugal

S. Lanceros-Mendez, The interplay of morphology and active response in electro-active microenvironments for tissue regeneration, SPARC-sponsored International Workshop on “Bioelectronic Medicine” December 16 2021, IIT (BHU), Varanasi, India.

P. Costa, S. Lanceros Mendez, Bilayered Materials for Wearable Electronics, Intensive Course in layered Materials & Applications 12th – 16th of July 2021, EU funded project CRETE : Critical Skills for Electronic Engineers of 2020, Co-Funded by the Erasmus + Programme,

C.M. Costa, S. Lanceros-Méndez, Advanced hybrid materials for printed and solid-state batteries: improving performance ad sustainability; 4th International Conference on Nanomaterials Science and Mechanical Engineering University of Aveiro, Portugal, July 6-9, 2021

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M. El Malki, Nelson Pereira, Senentxu Lanceros-Mendez, DEFECTS IN PERIODIC HELMHOLTZ RESONATORS WITH EXTENDED NECK, ITB Graduate School, 22/12/2021,

S. Lanceros-Mendez, Advanced Materials for next-generation Biomedicine, Biotechnology and Bioelectronics, New Materials for a Better Life Seminar, 25 October 2021 Bilbao, Spain.

Hybrid Multifunctional Materials for Remediation of Persistent Pollutants; Pedro M. Martins, 25 October 2021, BCMaterials, Bilbao, Spain.

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F.F. Rodrigues, J. Nunes-Pereira, M. Abdollahzadeh, J.C. Páscoa, and S. Lanceros-Mendez, Comparative evaluation of dielectric materials for plasma actuators active flow control and heat transfer applications (2021) in Fluids Engineering Division Summer Meeting, FEDSM2021, USA; hosted by ASME - The American Society of Mechanical Engineers.

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Optimization of Transparent SnOx and ZnO Thin Films for Thermoelectric Devices, E. M. F. Vieira, J. P. B. Silva, Advances in Energy Materials Mini-Symposium. School of Engineering and Material Science, Queen Mary University of London. 5 January 2021, London, United Kingdom (online).

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National

Reusable polymer hybrid membranes for arsenite and arsenate dual-water remediation, H. SALAZAR, P. M. MARTINS, A. VALVERDE, R. FERNÁNDEZ DE LUIS, J. L. VILAS, S. FERDOV, S. LANCEROS-MENDEZ, and G. BOTELHO, Encontro Nacional Sociedade Portuguesa de Química, July 14 – 16, 2021, Braga, Portugal.

Multifunctional nanocomposite membranes for environmental remediation of contaminants of emerging concern, H. SALAZAR, P. M. MARTINS, S. FERDOV, G. BOTELHO, and S. LANCEROS-MENDEZ, Jornadas LaPMET, September 23 – 24, 2021, Braga, Portugal.

Solid polymer electrolytes for solid-state lithium-ion batteries: Challenges and opportunities for next generation energy storage systems, J. C. Barbosa, C. M. Costa, S. Lanceros-Mendez, First Workshop of the Laboratory for Physics of Materials and Emerging Technologies, Setembro 2021 Braga, Portugal

N. Pereira, V.Correia, Nokola Perinka, C.M.Costa, S. Lanceros-Mendez "All-Printed Smart Label with Integrated Humidity Sensors, Communication System and Power Supply", 1st LapMET Workshop 23-24 th setember 2021, Braga, Portugal

Armando Ferreira, Webinar "Para uma moldação por injeção inteligente". Projeto Mobilizador TOOLING4G, University of Coimbra, 15/03/2021.

Contributed talks delivered at Conferences (International/National)

International

A Small-Scale Approach to Characterize Ti-Based Thin Films Tribological Behaviour in Operando Conditions, Aslihan Sayilan; Philippe Steyer; Sylvie Descartes; Nicolas Mary; Jose Ferreira; Christophe Goudin; C. Lopes; Joel Borges; Filipe Vaz; David Philippon; European Congress and Exhibition on Advanced Materials and Processes - EUROMAT 2021; 12–16 2021.

Covid-19 Impact on R&D Projects, Inês Alves; César Analide; Filipe Vaz, TAKE 2021 Theory and Applications in the Knowledge Economy – July, 7th – 9th, Virtual Conference – Portugal.

Scientific Production in Portuguese Public Universities, Inês Alves; César Analide; Filipe Vaz, 12th International Symposium on Ambient Intelligence, Salamanca, Spain, 6 - 8 October, 2021.

The relationship between Financial Execution in R&D and Scientific Production, Inês Alves; César Analide; Filipe Vaz, 18th International Conference on Distributed Computing and Artificial Intelligence, Salamanca, Spain, 6 - 8 October, 2021.

How to engage engineering students to physics: A case report of an introductory physics course taught in the first year of an engineering programme. C. Moura, R. Oliveira, J. Silva, 13th International Symposium on Project Approaches in Engineering Education and 18th Active Learning in Engineering Education Workshop, PAEE/ALE 2021; 11:359-366, (2021).

Transparent Thermoelectric TiO2:Nb Thin Films, Carlos J Tavares. International Conference on Metallurgical Coatings and Thin Films (ICMCTF) 2021, Session Title: C3: Thin Films for Energy Applications: Solar, Thermal, and Photochemical, April 26-30 2021, United States (virtual conference).

Transparent thermoelectric ZnO-based thin films for thermal energy harvesting: the role of Ga and Bi doping, Carlos J Tavares. 16th European Vacuum Conference (EVC16), Marseille, France, Novemver 22-26 2021. (https://www.evc16.org/)

A new generation of microfluidic platforms based on smart and multifunctional Materials, Brito-Pereira R, Cardoso V.F, Lanceros-Mendez S, VII International Conference IMFAHE, 31 May, 2021, Boston, USA (Online)

Photocatalytic PVDF/TiO2:Au nanostars membranes for ciprofloxacin in water remediation; Fangyuan Zheng; Pedro M. Martins; Senen Lanceros Méndez; Javier Reguera Gómez; ImagineNano2021 – International Event – Composites2021 Conference, Bilbao, 23-25 november 2021

Electrospun poly(3-hydroxybutyrate-co-hydroxyvalerate) based nancomposite membranes for lithium-ion battery separators, J.C. Barbosa, D.M. Correia, A. Fidalgo-Marijuan, R. Gonçalves, M. Fernandes, V. de Zea Bermudez, M.M. Silva, C. M. Costa, S. Lanceros-Mendez, XV Spanish National Meeting on Electroceramics, Vitoria-Gasteiz, Espanha, 7 to 9 julho de 2021.

Ionic liquid/polymer hybrid materials for printable humidity, thermochromic and thermoresistive sensors, D.M. Correia, L.C. Fernandes, N. Pereira, M. Tariq, J.M.S.S. Esperança, S. Lanceros-Mendez, 6th Iberoamerican Meeting on Ionic Liquids. IMIL 2021, 24th to 26th of May 2021, Chile

Ferroelectricity in epitaxially strained rhombohedral ZrO2 thin films, J.P.B. Silva, F.G. Figueiras, R.F. Negrea, M.C. Istrate, S. Dutta, H. Aramberri, J. Íñiguez, C. Ghica, K.C. Sekhar, A.L. Kholkin. 38th International Symposium on Dynamical Properties of Solids – DyProSo 2021. 6-8 September 2021, University of Luxembourg.

Ferroelectricity in epitaxially strained rhombohedral ZrO2 thin films, J.P.B. Silva, F.G. Figueiras, R.F. Negrea, M.C. Istrate, S. Dutta, H. Aramberri, J. Íñiguez, C. Ghica, K.C. Sekhar, A.L. Kholkin. 4th International Conference on Nanomaterials Science and Mechanical Engineering University of Aveiro, Portugal, 6-9 July 2021.

Resistive switching characteristics of the ZnO:Ca thin films deposed by PLD on silicon substrates,I. H. Mejri, K. Omri, I. Ghiloufi, J. P.B. Silva, M. Pereira, M. J. M. Gomes, L. El Mir, International Meeting on Advanced Materials (IMAM-2021) Hammamet, Jun, 28-30 -2021, Tunisia.

First-principles and molecular dynamics study of Ag transport in self-lubricating coatings, V Lenzi, D Cavaleiro, A Cavaleiro, F Fernandes, LSA Marques. EUROMAT 2021, Graz (Virtual), Austria, 13-17 September 2021

- Evaluation of the best solution for the functionalization of photocatalytic, superhydrophobic, and self-cleaning properties on asphalt mixtures. Rocha Segundo, Iran.; Landi JR., Salmon; Freitas, Elisabete; Costa, Manuel F. M.; Zahabizadeh, Behzad.;

Cunha, Vítor M. C. F.; Soares, G.; Santos, J.; Teixeira, V., Carneiro, Joaquim. In: EOS Annual Meeting (EOSAM) 2021, 13-17 September 2021, Rome, Italy. https://www.europeanoptics.org/events/eos/eosam2021.html

- Considerations about the determination of the band gap from diffuse reflectance spectroscopy. Landi JR., Salmon; Rocha Segundo, Iran.; Freitas, Elisabete.; Vasilevskiy, M.; Tavares, C.; Carneiro, Joaquim. In: The 3rd International Workshop Advances on Photocatalysis including Environmental and Energy Applications AdvPhotoCat-EE 2021, 28-29 June 2021, Bucharest, Romania.

- Application of nano-TiO2 and micro-PTFE on Recycled Asphalt Mixtures for Superhydrophobic Functionalization. Rocha Segundo, I.; Landi JR., Salmon.; Freitas, Elisabete.; Costa, Manuel F. M.; Teixeira, V.; Zahabizadeh, Behzad.; Vítor M. C. F.; Soares, G.; Santos, J.; Carneiro, J. In: NanoPortugal (NPTO2021) Online Conference, 16-17 September 2021, Portugal. https://www.confstreaming.com/nanoPT2021/index.php

- Application of nano/microparticles on asphalt mixes to promote photocatalysis and superhydrophobicity. Rocha Segundo, I.; Freitas, Elisabete.; Carneiro, Joaquim. In: 4th Asphalt Innovation Symposium, Online Conference, 15-16 December 2021, Antwerp, Belgium. https://medialibrary.uantwerpen.be/files/11073/2f735b62-3f36-4031-b0e5-3cd84fd1cf43.pdf

- Photocatalytic performance of textiles coated with TiO2-RGO system for degradation of crude petroleum under similar solar irradiation. Landi JR., Salmon.; Silva, D., Fernandes, Filipa Daniela.; Nunes, E.; Teixeira, V.; Moreto, J.; Rocha Segundo, Iran.; Carneiro, Joaquim. In: 17th International conference on Advanced Nano Materials - ANM 2021, 22-24 July 2021, Aveiro, Portugal. https://www.advanced-nanomaterials-conference.com/anm-home/

- Development of a magnetron sputtering deposition process for In2O3:H transparent back contact for Cu(In,Ga)Se2-based solar cells. Alves, M., Sadewasser S., Teixeira V., Carneiro, J. In: NanoPortugal (NPTO2021) Online Conference, 16-17 September 2021, Portugal.

VET STUDENTS İNTO TECHNOLOGY COMPANİES: A MICROLEARNING DIGITAL COURSE TO TRAIN CRITICALTHINKING SKILLS, L. Gómez Estrada, L. Pietra, S. Randaccio, A. Soriano Martínez, P.Karampelas, A.M. Almeida, J.S. Nunes, J.M. Martínez Ardil, M.T. Guillot-Ferriols, S. Clara-Trujillo, C. Solano-Ma rtínez, L. Gómez-Estrada, J.L.Gómez Ribelles EDULEARN21: 13th annual International Conference on Education and New Learning Technologies Held virtually on the 5th and 6th of July, 2021.

Exploring portable Ultrasonic Pulse Velocity avails in the Conservation Assessment of Plaster Sculptures in Museum environment. António Mário Almeida, Mário António Pereira, Graça Vasconcelos, Salomé Carvalho, Rui Bordalo, Eduarda Vieira, Sculpt 21 – Shaping Genealogies – 1st International Conference on Late 19th and Early 20th Century Sculpture Escola de Artes, Universidade Católica – Porto - Evento On-line, 7 e 8 de outubro de 2021

Skin Neoplasia Early Detection by Fractal Analysis of Images and 3D Inspection, Manuel F. M. Costa, ZEISS Symposium 2021 - Optics in the Medical World, online, June 8-9, 2021. https://www.zeiss.com/corporate/int/newsroom/events/zeiss-symposium.html (oral)

Photovoltaic solar energy: a pedagogic approach. Castro, J. F., Joaquim AO Carneiro, and Manuel FM Costa. 18th International Conference on Hands-on Science, online, July 19-23, 2021. www.hsci.info/hsci2021

Introducing programming to basic schools students using robotics. V. Martins, L. Martins and Manuel FM Costa. 18th International Conference on Hands-on Science, online, July 19-23, 2021. www.hsci.info/hsci2021

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Application of nano-TiO2 and micro-PTFE on Recycled Asphalt Mixtures for Superhydrophobic Functionalization, Rocha Segundo, I.; Landi JR., Salmon.; Freitas, Elisabete.; Costa, Manuel F. M.; Teixeira, V.; Zahabizadeh, Behzad.; Vítor M. C. F.; Soares, G.; Santos, J.; Carneiro, J.. In: NanoPortugal (NPTO2021) Online Conference, 16-17 September 2021, Portugal. (https://www.confstreaming.com/nanoPT2021/index.php).

Energias Renováveis em África. Carneiro, Joaquim., Teixeira, Vasco., Costa, Manuel F. M., Seminários do ISPTEC, 28 de Outubro de 2021, Luanda, Angola.

Cr-Based Sputtered Decorative Coatings for Automotive Industry, Edgar Carneiro, Nuno M. G. Parreira, Todor Vuchkov, Albano Cavaleiro, Jorge Ferreira, Martin Andritschky and Sandra Carvalho, 16th European Vacuum Conference, Marseille, France, 25 de Novembro de 2021

Modification of steel-polymer interfacial adhesion using Al2O3 and TiO2 surfaces produced via ALD, M.J. Lima, R.M. Silva, K. Gonzalez, J.D. Castro, F. Oliveira, R. F. Silva, S. Carvalho, Euromat 2021, September 2021

New cytocompatible and antibacterial porous Ta_2O_5 surface: dental implant prototype, L. Fialho, L. Grenho, M. H. Fernandes, L. Forte Martins, S. Carvalho, ICMCTF 2021 - 47th International Conference on Metallurgical Coatings and Thin Films, Virtual Conference, April 2021.

Development of new osseointegrated and antimicrobial tantalum implant, Luísa Fialho, Liliana Grenho, Maria Helena Fernandes, Sandra Carvalho, EUROMAT 2021 – European Congress and Exhibition on Advanced Materials and Processes, Virtual Conference, September 2021

National

Avaliação em duas etapas: como transformar um processo de avaliação numa experiência de aprendizagem colaborativa e formativa. Cacilda Moura. 7º Congresso Nacional de Práticas Pedagógicas no Ensino Superior (CNaPPES.21), Universidade de Aveiro, 12 a 16 de julho de 2021 https://cnappes.org/files/2021/08/Livro_Resumos_CNaPPES.pdf

A solid polymer electrolyte based on poly(vinylidene fluoride-co-hexafluoropropylene) combining ionic liquid and zeolite for room temperature lithium-ion battery applications, J. C. Barbosa, D.M. Correia, A. Fidalgo-Marijuan, R. Gonçalves, S. Ferdov, C. M. Costa, V. de Zea Bermudez, S. Lanceros-Mendez, XXVII Encontro Nacional da Sociedade Portuguesa de Química, Julho 2021, Braga, Portugal

Development of cytocompatible and antibacterial porous tantalum oxide surfaces doped with zinc oxide nanoparticles, Luísa Fialho, Maria Helena Fernandes, Sandra Carvalho, Symposium of Materials Science and Engineering of DCE21 - 4th Doctoral Congress in Engineering, Porto, Portugal, June 2021.

Cr-Based Sputtered Decorative Coatings for Automotive Industry, Edgar Carneiro, Nuno M. G. Parreira, Todor Vuchkov, Albano Cavaleiro, Jorge Ferreira, Martin Andritschky and Sandra Carvalho, Workshop Vácuo 2021, Instituto Pedro Nunes, Coimbra, 9 de Novembro de 2021

7.3.6 National/international Patents

National

International

Modular magnetically driven bioreactor system for cellular cultures and biomedical applications". V. Correia, C. Ribeiro, N. Castro, S. Lanceros-Méndez. 20.10.2021 Bulletin 2021/42" - EP 3 896 149 A1

7.3.7 SPIN-OFFS, START-UPS

COATIT – Desenvolvimento Superfícies Inteligentes – Spin-off da UMinho. Team: Filipe Vaz, Armando Ferreira, Nuno Silva, Maria Carolina Valente.

PHOTOCAPSULES Lda., spin-off da Universidade do Minho. Carlos Tavares

7.3.8 Supervision of Research Students

7.3.8.1 PhD projects completed in 2021

Author	Supervisor	Title	Host institution/Program	Reference
Bruna Gonçalves	Senentxu Lanceros-Mendez, Yury V. Kolen'ko and Gabriela Botelho	Novel printable photovoltaic systems based on Cu(In,Ga)Se2 chalcopyrite	Materials Engineering doctoral program	SFRH/BD/121780/2016
Diogo Cavaleiro	Sandra Carvalho and Filipe Fernandes	The importance of Ag content for optimizing the machining performance of Ti-Si-(Ag)-N coatings	Materials Engineering doctoral program	UMINHO/BD/29/2016
Luísa Fialho	Sandra Carvalho and Maria Helena Fernandes	Design of new biocompatible osseointegrated and antimicrobial dental implant	Materials Engineering doctoral program	UMINHO/BD/31/2016
Marco S. Rodrigues	Filipe Vaz / Joel Borges	Gas sensing with nano-designed LSPR thin films using GLAD in reactive magnetron sputtering	University of Minho / MAP-Fis Doctoral Program	SFRH/BD/118684/2016

7.3.8.2 PhD projects in progress in 2021

Author	Supervisor	Title	Host institution/Program	Reference	Starting Date
Ana Catarina Branco Lima	Pedro Libânio Martins, S. Lanceros Mendez	New inks for printed electronic components and sensing devices: integration into a fully printed magnetic sensor	PhD Program in Materials Engineering	SFRH/BD/132624/2017	01/09/2017
André Gustavo Silva Macedo	C. Ribeiro, V.F. Cardoso, S. Lanceros-Méndez	Multiresponsive hydrogels as a novel approach for bone cancer therapies	PhD Program in Materials Engineering	2020.09218.BD	01/05/2021
António Castro	Luís Silvino Alves Marques	Oxidation mechanism of bimetallic ZnFe nanoparticles	PhD program in Engineering and Surface Protection- SURFPROTEC	SFRH/BD/118721/2016	01/12/2016

Belgacem Tiss	L. Cunha. Diego Martínez	Deposition of UV-protective oxide films on complex substrate: cork and rubber.	PhD Program in Materials Engineering		
Bruno Alexandre Alves Santos	Senen Lanceros Mendez / Margarida Maria Francesko Fernandes	Multifunctional self-healing photocatalytic and antimicrobial membranes for emerging pollutants water remediation	PhD Program in Materials Engineering	2020.09630.BD	01/11/2020
Catarina Isabel da Silva Olveira	Diego Martinez-Martinez, Luís Cunha, Jeff de Hossom	Deposition and characterization of sputtered Zr-O-N based films for fine tuning of their physical properties	PhD Program in Materials Engineering	Own	06/03/2018
Daniela Morais	Vítor Vilar e Francisca Moreira (FEUP), Carlos JTavares	A continuous-flow photoelectrocatalytic static mixer microreactor applied to the synthesis of high-value organic chemicals	Programa Doutoral: Engenharia Química e Biológica (FEUP) Estudante	SFRH/BD/146476/2019	01/07/2020
Diana Isabela Faria Meira	Filipe Vaz, Joel Borges, Vitor Correlo (I3Bs)	Development of nanoplasmonic thin film biosensors with enhanced sensitivity for detection of Ochratoxin-A	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/143262/2019	
Diogo Coelho da Silva	Pedro Libânio de Abreu Martins / Senentxu Lanceros-Mendez	Conformable electronics materials and solutions for advanced applications: ConfTronics	Doctoral Program in Physics (MAP-Fis)	UI/BD/151181/2021	01/05/2021
Diogo Emanuel Carvalho Costa	Filipe Vaz, Graça Minas, Paula Sampaio	Development of Optical (T-LSPR) Biosensors, based in nanoplasmonic thin films, for early pathogen detection	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/136279/2018	01/01/2019
Diogo Jorge Martins Ramos	Sandra Carvalho /Albano Carvalho (Un. de Coimbra)	Development of new coatings for dental implants	PhD program in Engineering and Surface Protection- SURFPROTEC	UMINHO/BD/56/2018	10/05/2018
Edgar Manuel Neto Carneiro	Sandra Carvalho	REACH Regulation: Alternative coatings to hexavalent chromium.	PhD Program in Materials Engineering	UMINHO/BD/30/2016	01/12/2016
Eduardo José de Sousa Pimetel	Daniel António da Silva Miranda / Senen Lanceros Mendez	Printable piezoresistive materials based on natural polymers for medical device application	IPCA	UIDP/05549/2020 – BID1	01/03/2021
Elmahdi Amar	Sascha Sadewasser / João Pedro Agorreta Alpuim	Characterization of single-photon emitting defects in 2D materials by scanning probe microscopy (SPED-Probe)	Doctoral Program in Physics (MAP-Fis)	INL	
Estela Marisa Oliveira Carvalho	M.M. Fernandes, C. Ribeiro, S. Lanceros Mendez	Improving Titanium-Bone interfaces with electroactive and antimicrobial materials for effective orthopedic implants	PhD Program in Materials Engineering	SFRH/BD/145455/2019	01/11/2019
Filipe Costa Correia	Carlos J Tavares, Adélio Mendes (FEUP)	Desenvolvimento de filmes finos heteroestruturados em ZnO com propriedades	PhD Program in Materials Engineering	SFRH/BD/111720/2015	08/09/2015

		termoeléctricas em células solares			
Hugo Higino Martins Salazar	Stanislav Ferdov / Maria Gabriela Botelho / Senen Lanceros Mendez	New generation of polymer composite membranes for water purification	PhD Program in Materials Engineering	SFRH/BD/122373/2016	04/09/2017
Iran gomes da Rocha Segundo	Elisabete Freitas (EEUM), Joaquim Carneiro (ECUM)	Superfícies de Pavimentos Rodoviários Ecológicas, Fotocatalíticas, Hidrofóbicas e Autolimpantes	PhD Program in Materials Engineering	SFRH/BD/137421/2018	01/09/2018
Isabel Alves Lopes	Rui Vilar (IST), Luis Rebouta	Optical and tribological properties of femtosecond laser nanotextured surfaces	PhD in Advanced Materials and Processing - AdvaMTech	PD/BD/143034/2018	01/06/2018
Joana Catarina Dias Moreira Moreira	Margarida M. Fernandes, Daniela Correia, S. Lanceros Mendez	Physical active antimicrobial surfaces for preventing the spread of pathogenic microorganisms	PhD Program in Materials Engineering	2021.087096.BD	01/11/2021
Joana Margarida da Silva Ribeiro	Carlos J Tavares, Torbel Boll (KIT, Germany)	Transparent thermoelectric titanium dioxide-based thin films for thermal energy harvesting	PhD Program in Materials Engineering	SFRH/BD/147221/2019	01/01/2020
Joana Marina Silva Queirós	S. Lanceros Mendez; Pedro M. Martins	Wide range polymeric membranes towards water remediation of contaminants of emerging concern	PhD Program in Materials Engineering	2021.08822.BD	01/10/2021
João Carlos Pacheco Barbosa	Verónica de Zea Bermudez, Carlos Costa, S. Lanceros-Mendez	Development of three component solid-polymer electrolytes for energy storage applications	PhD Program in Materials Engineering	SFRH/BD/140842/2018	01/10/2018
João Luís Rodrigues Teixeira	Maria Gabriela Botelho / Senen Lanceros Mendez	Multifunctional air filters based on emerging natural polymers for VOCs removal	PhD Program in Materials Engineering	SFRH/BD/141642/2018	01/10/2018
João Pedro Cruz Serra	Senen Lanceros Mendez / Carlos Costa / Pedro Filipe Costa	Natural polymer based multifunctional materials for sensing applications	PhD Program in Materials Engineering	2021.08158.BD	01/10/2021
Jorge Manuel Pereira Sousa	Elisabete Freitas (EEUM), Joaquim Carneiro (ECUM)	Incorporation of Composite Phase Change Materials into Asphalt Mixtures for Cooler Pavements	PhD in Civil Engineering (EEUM)	2021.08393.BD	01/09/2021
Juliana Filipa Gouveia Marques	Carlos J Tavares	Difusão controlada de compostos ativos do interior de microcápsulas mediada por ativação solar	PhD Program in Materials Engineering	SFRH/BD/112868/2015	01/01/2016
Liliana Sofia Correia Fernandes	Pedro Libânio Martins, Daniela Correia, Senen Lanceros Mendez	Magnetic ionic liquid/polymer composites for printable sensors and actuators	PhD Program in Materials Engineering	SFRH/BD/145345/2019	01/11/2019
Maria Manuela Carvalho Proença	Filipe Vaz, Joel Borges	Nanoplasmonic thin films of Au-Ag/MOx functionalized with molecular recognition elements to enhance sensitivity and selectivity of LSPR gas sensors	Doctoral Program in Physics (MAP-Fis)	SFRH/BD/137076/2018	01/12/2018

Marina do Carmo Alves	Joaquim Carneiro (ECUM), Sascha Sadewasser (INL)	Fabrication and characterization of micro-concentrator solar cells based on Cu(In,Ga)Se2	PhD Program in Materials Engineering	2020.06063.BD	01/03/2021
Marta Adriana Félix Forte	Carlos J Tavares, Rui Silva (U. Aveiro)	Encapsulation of phytonutrients in polymeric microcapsules coated with photocatalytic nano materials	PhD in Advanced Materials and Processing - AdvaMTech	PD/BD/128491/2017	01/01/2017
Miguel Alexandre Franco	S. Lanceros Mendez, Asal Kiazadeh	Development of printed and biocompatible synaptic devices	PhD Program in Materials Engineering	SFRH/BD/145741/2019	06/01/2020
Nelson Miguel da Silva Pereira	Senentxu Lanceros-Mendez Vitor Correia	Development of multifunctional inks for the implementation of interactive applications	Doctoral program in Electronics and Computers Engineering	SFRH/BD/131729/2017	01/09/2017
Rafael dos Santos Pinto	Carlos Costa, S. Lanceros Mendez, Renato Gonçalves	Two- and three-dimensional sustainable solid-state printed batteries for portable electronic devices	PhD Program in Materials Engineering	2021.07361.BD	01/10/2021
Rafaela Marques Meira	Senen Lanceros Mendez /Clarisse Ribeiro / Daniela Correia	Electroactive polymer materials based heart-on-a-chip as a novel approach for cardiac tissue engineering	PhD Program in Materials Engineering	SFRH/BD/148655/2019	01/11/2019
Ricardo Jorge Brito Gonçalves Pereira	Vanessa Fernandes Cardoso / Senen Lanceros Mendez	A new generation of microfluidic platforms based on smart and multifunctional materials	PhD Program in Materials Engineering	SFRH/BD/140698/2018	01/10/2018
Ricardo José da Silva Lima	J. Nunes-Pereira, Senen Lanceros Mendez, Pedro Filipe da Costa	Advanced self-sensing polymer composites with self-healing capabilities for high responsibility applications	PhD Program in Materials Engineering	2020.07010.BD	01/12/2020
Rita de Magalhães Policia	Senen Lanceros Mendez, Pedro Libânio Martins, Daniela Correia	High-performance printable luminescent and chromic materials for improved device integration	PhD Program in Materials Engineering	2020.07956.BD	01/10/2020
Sérgio Abílio Pereira Gonçalves	Pedro Sérgio Oliveira Branco, Senen Lanceros-Méndez, José Gerardo Rocha	New generation of interactive platforms based on novel printed smart materials	Doctoral programo on electronics and computer engineering	UMINHO/BI/337/2019	01/09/2019
Teresa Isabel Marques de Almeida	Senen Lanceros Mendez, Clarisse Marta de Oliveira Ribeiro	Biodegradable electroactive polymer materials as a novel approach for neural tissue engineering applications	PhD Program in Materials Engineering	SFRH/BD/141136/2018	01/10/2018
Tiago André Rodrigues Marinho	Senen Lanceros-Mendez, Pedro Costa, Vitor Correia	Printable energy harvester systems for wearable sensors devices	PhD Program in Materials Engineering	SFRH/BD/140242/2018	01/10/2018

7.3.8.3 MSc projects completed in 2021

Author	Supervisor	Title	Host institution/Program
Bruno Fernandes Esteves da Eira	Joaquim Carneiro	Dimensionamento e contributo de um sistema solar fotovoltaico para a sustentabilidade energética da ETAR Paço de Sousa	Mestrado em Ciências e Tecnologias do Ambiente Ramo de Energia, ECUM
Inês Lucas Amorim Alves	César Anlaide (DI), Filipe Vaz	Intelligent Data Analysis from the Financial Execution of Research Projects at University of Minho	EEUM
Rafael Fonseca	Pedro Costa Senentxu Lanceros-Mendez	Impressão bi- e tridimensional de compósitos piezoresistivos multifuncionais	Mestrado em Micro e Nanotecnologia - EEUM
João Marcos	Teresa Valente, Pedro M. Martins	Caracterização de nanopartículas naturais em ambientes sujeitos a contaminação mineira	ECUM
Joana Marina Silva Queirós	Senentxu Lanceros, Pedro M. Martins; Vanessa Cardoso	Produção de membranas nanocompósitas para adsorção de metais pesados	EEUM
Divaldo Carlos Pedro Mateus	Vitor Manuel Correia: S. Lanceros Mendez	Desenvolvimento de uma pele artificial para avaliação da sensibilidade a estímulos elétricos	Mestrado Integrado em Engenharia de Materiais
Bárbara Daniela Duarte Cruz	Gabriela Botelho e Daniela Correia	Materiais fotoluminescentes imprimíveis para identificação e segurança	ECUM
Rui Miguel Gonçalves Carvalho	P. Martins, S. Lanceros-Mendez	Desenvolvimento de revestimento antigelo, fotocatalítico e autolimpante para pavimentos flexíveis com o uso de nano e micromateriais	EEUM, Mestrado Ciência e Tecnologias do Ambiente-Energia
Vera Lúcia Matos Macedo	P. Martins, S. Lanceros-Mendez	Materials and processes for 3D printed electronics	ECUM
Sara Beatriz Sousa Amorim	Clarisse Ribeiro, Senentxu Lanceros-Mendez	Avaliação do potencial dos biomateriais electricamente activos para o combate ao cancro ósseo	UM Mestrado em Micro/Nano Tecnologias
Anabel Oliveira Campos	Clarisse Ribeiro, Senentxu Lanceros-Mendez	Electroactive and bioactive three dimensional structures for tissue engineering	UM Mestrado integrado em Engenharia de Materiais

8.Appendices

8.1 Externally funded projects at CFUM ("Projetos Individuais"), ongoing in 2021

Funding entity	Title	Researcher	Start date	End date	Global Budget - UM
FCT	Atrito-0 - PTDC/EME-SIS/30446/2017	Sandra Maria Fernandes Carvalho	01/06/2018	31/05/2022	75 206,25 €
ANI	GNESIS	Nuno Miguel Machado Reis Peres	01/08/2018	27/07/2021	413 325,89 €
ANI	Science DiabetICC	Sandra Carvalho	20/08/2019	30/09/2021	430 948,51
FCT	DEMOM - PTDC/NAN-MAT/28538/2017	Bernardo Gonçalves Almeida	01/07/2018	30/04/2022	46 012,50 €
FCT	To CHAIR - PTDC/MAT-APL/28247/2017	Sofia Oliveira Lopes	01/06/2018	31/05/2022	168 785,31 €
FCT	PTDC/FIS-MAC/28114/2017	Nuno Miguel Machado Reis Peres	01/07/2018	30/06/2022	78 211,01 €
FCT	NLINOP2DMAT - PTDC/FIS-MAC/28887/2017	Nuno Miguel Machado Reis Peres	15/07/2018	31/03/2022	27 010,12 €
FCT	PTDC/QUI-QFI/28020/2017	Paulo José Gomes Coutinho	01/07/2018	31/12/2021	158 483,17 €
FCT	LensUM - PTDC/FIS-OTI/31486/2017	Sandra Maria Braga Franco	01/07/2018	30/06/2022	184 658,12 €
FCT	PTDC/BTM-MAT/28237/2017	Clarisse Marta Oliveira Ribeiro	01/07/2018	30/06/2022	220 458,12 €
FCT	PTDC/NAN-MAT/32651/2017	Marlene Susana Dionísio Lúcio	01/07/2018	30/06/2022	238 120,65 €
FCT	PTDC/NAN-OPT/29265/2017	Michael Scott Belsley	01/07/2018	31/03/2022	234 301,87 €
FCT	FLIP - PTDC/FIS-MAC/29454/2017	Bernardo Gonçalves Almeida	10/08/2018	31/03/2022	55 543,45 €
FCT	PTDC/FIS-MAC/32299/2017	José Filipe Vilela Vaz	01/07/2018	30/06/2022	117 558,20 €
FCT	PTDC/BIA-MOL/31069/2017	João Pedro Santos Hall Alpuim	15/06/2018	14/06/2022	43 712,50 €
FCT	PTDC/NAN-OPT/29417/2017	João Pedro Santos Hall Alpuim	01/06/2018	31/05/2022	31 737,50 €

FCT	PTDC/EMD-EMD/28159/2017 – EC	Vanessa Fernandes Cardoso	01/07/2018	30/06/2022	123 894,29 €
FCT	PTDC/FIS-MAC/28157/2017	Carlos Miguel Silva Costa	01/10/2018	30/09/2022	210 158,12 €
FCT	PTDC/CTM-REF/28108/2017	Marta Maria Duarte Ramos	01/10/2018	31/07/2022	164 707,40 €
ANI	On-Surf - POCI-01-0247-FEDER-024521	José Filipe Vilela Vaz	01/10/2018	31/03/2022	478 235,35 €
FCT	PTDC/MAT-APL/28118/2017	Stéphane Louis Clain	14/12/2018	13/12/2021	154 045,62 €
FCT	PTDC/ART-OUT/31304/2017	Mário António Caixeiro Castro Pereira	01/06/2018	31/10/2021	37 500,00 €
FCT-Bilateral	Cooperação Bilateral Pessoa (França)	José Filipe Vilela Vaz	01/01/2019	31/12/2021	3 000,00 €
FCT-Bilateral	FCT-CNRST	José Pedro Basto da Silva	01/01/2019	31/12/2021	3 000,00 €
European Commission	INDESMOF - 778412	Carlos Miguel Silva Costa	01/03/2018	28/02/2022	166 500,00 €
ANI	ReleaseME - 33268	Carlos José Macedo Tavares	01/08/2019	31/07/2022	301 959,36 €
ANI	MAG4Biomed - 42852	Elisabete Maria Castanheira Coutinho	15/01/2019	14/04/2022	12 087,14 €
ANI	ORAIDEA - 39985	Sandra Maria Fernandes Carvalho	01/07/2020	30/06/2023	114 101,17 €
ANI	GREENCoat - 42785	Martin Andritschky	01/09/2019	31/08/2022	319 819,47 €
European Commission	GrapheneCore3 - 881603	Nuno Miguel Machado Reis Peres	01/04/2020	31/03/2023	202 400,00 €
FCT-Bilateral	CTA_PT/Sérvia	Margarida Maria Macedo Francesko Fernandes	01/01/2019	31/12/2021	4 000,00 €
ANI	45940 - MCTools21	Luís Silvino Alves Marques	01/04/2020	31/03/2023	258 535,27 €
ANI	45908 - NanoStim	José Filipe Vilela Vaz	01/01/2020	31/12/2022	252 003,39 €
ANI	GEMIS- POCI-01-0247-FEDER-045939	Nuno Miguel Machado Reis Peres	01/06/2020	31/05/2023	250 004,41 €
European Commission	2019-1-ES01-KA201-065750	António Mário Lourenço Fonseca Almeida	01/09/2019	31/08/2022	13 382,00 €
ANI	I4REV - 042783	Luis Rebouta	19/02/2020	18/02/2023	143 524,79 €

ANI	4NoPressure - 39869	Carlos José Macedo Tavares	01/06/2020	30/06/2023	82 549,60 €
FCT	CERN/FIS-TEC/0039/2019	Maria Fátima Guimarães Cerqueira	01/07/2020	30/06/2022	4 750,00 €
European Commission	2019-1-ES01-KA202-064569	António Mário Lourenço Fonseca Almeida	01/09/2019	31/08/2022	11 457,85 €
European Commission	OBERON - 956720	José Manuel González Meijome	01/01/2021	31/12/2024	721 680,48 €
European Commission	2020-1-PT01-KA201-078451	António Manuel Gonçalves Baptista	01/09/2020	31/10/2022	29 940,00 €
FCT	PTDC/FIS-MAC/6606/2020	Joaquim Alexandre Santos Almeida Oliveira Carneiro	29/03/2021	28/03/2024	249 531,73 €
FCT	PTDC/CTM-REF/0155/2020	Diego Martínez Martínez	01/02/2021	31/01/2024	202 719,44 €
FCT	PTDC/NAN-MAT/0098/2020	Bernardo Gonçalves Almeida	01/01/2020	31/12/2023	61 986,47 €
FCT – PE	UIDB/04650/2020	Luís Rebouta	01/01/2020	31/12/2023	1 052 616,28 €
FCT - PE	UIDP/04650/2020	Luís Rebouta	01/01/2020	31/12/2023	496 616,96 €
ANI	REPEL+-47036	Carlos José Macedo Tavares	01/06/2021	30/06/2023	296 556,88 €

8.2 Key Words by Research Line

8.2.1 Assessment and enhancing visual performance

Binocular vision	Color science	Ocular accommodation
Color science	Computational models	Ocular disease
Epidemiology	Contact lenses	Ocular surface
Visual assessement	Dry eye	Ophthalmic instrumentation
Ocular accommodation	Electrophysiology	Optical modelization
Ocular growth	Epidemiology	Optics
Ocular surface	Glare	Perception
Optics	Hyperspectral imaging	Presbyopia
Perception	Image quality metrics	Refractive surgery
Visual electrophysiology Visual enhancement	Intraocular lenses	Rehabilitation
Visual optics	Irregular cornea	Retina
Visual rehabilitation	Keratoconus	Stereoscopic vision
Aberrometry	Low vision	Tear film
Accommodative disorders	Microbial contamination	Vision performance
Adaptive optics	Myopia	Visual ergonomics
Augmented reality	Myopia control	Visual optics
Binocular vision	Myopia progression	Visual optimization
		Visual therapy

8.2.2 Physics of quantum materials and bionanostructures

Electronic structure,	FRET (Forster Resonance Energy Transfer)	Photocatalysis
(Bio)Sensors	Graphene	Plasmonic nanostructures
2D materials	Lipid (bi)layer	Quantum dot
Anti-tumour drugs	Luminescence	Quantum materials
Biomolecules	Magnetic nanoparticles	Quantum nanostructures
Bionanoconjugates	Mathematical Physics	Raman and Infrared Spectroscopy
charge carrier dynamics,	Nanocarriers	Solar Cells
Density Functional Theory (DFT)	Nanomedicine	Sol-gel
Drug delivery	Nonlinear optical materials	Surface Enhanced Raman Spectroscopy
Energy transfer / FRET	Optimal Control Theory	Surface plasmon resonance
Exciton	Partial differential equations	Thin films
Finite elements	Phase transitions	Transport properties,
Fluorescent probes	Phonon	Ultrafast Spectroscopy
Piezoelectric	pyroelectric properties	

8.2.3 Functional and smart materials and surfaces for advanced applications

Actuator	HWCVD - Hot wire chemical vapour deposition	Photoluminescense, fluorescence
Biomaterials	Hybrid material	Piezoelectric
Biosensor	Laser ablation	PLD - Pulsed laser deposition
Coating	Magnetoelectrics and magnetic properties	Printed, printing
Coating - antibacterial	Membrane	PVD - physical vapour deposition
Coating - medical device	Microporous	Sensor
Crystal growth	Modelling, materials modelling	Smart material
Crystallography	Nanomaterial, nanocluster, nanoparticle	Smart polymer
Decorative coating	Nanoporous	Solar cell
Density functional theory	Nitride	Sputtering
Detector	Non-linear optics	Surface topography, tribolofy, wettability
Electrical, thermal, mechanical properties	Optical properties	Synthesis
Energy harvesting	Oxide	Thin film, thin layer
Ferroelectric	Photocatalysis, catalysis	