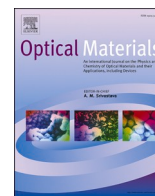




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Shining a light on biomedical and energy applications

Preface

Dear Colleagues and friends of the SHIFT Conference Series, dear “Shifters”:

well-known near-infrared therapeutic windows (deeper penetration and lower tissue damage) and subsequent wavelength transformation to higher or lower energies provides ground-breaking applications in photodynamic cancer therapy and bio-imaging. Interdisciplinary efforts from physics, chemistry, biology, medicine, materials science and engineering will certainly be required to overcome current challenges



“Shifters” at Tenerife, around 80 universities in 29 countries meeting face-to-face at SHIFT2022 Conference (El Teide volcano National Park, 12th October 2022).

We are pleased to have this Special Issue of *Optical Materials* published following the successful SHIFT 2022 Conference “Spectral sHapIng For biomedical and energy applicaTions” held in Tenerife, Canary Islands (Spain) on October 10–14, 2022. The organizers: Universidad de La Laguna (Tenerife, Spain), with the financial support of the Canary Islands Government “Gobierno de Canarias”, Canary Islands Special low tax Zone (ZEC), City Hall of La Laguna “Ayuntamiento de La Laguna” and “Cabildo de Tenerife”, acknowledge all participants and authors for their valuable contributions to this Special Issue, entitled “Shift: shining a light on biomedical and energy applications”.

Spectral shaping of light is an emerging route for enhancing the efficiency of various solar energy harvesting, storage and conversion processes facing the increasing demand for energy supply, from photovoltaics to photocatalysis, natural and artificial photosynthesis and solar fuels generation, where usually large parts of the solar spectrum are not efficiently utilized. Moreover the use of light in life sciences, within the

leading the way for spectral shaping of light to be a future key technology. The SHIFT (Spectral sHapIng For biomedical and energy applicaTions) International Conference series emerges as a cutting-edge, multidisciplinary platform to gather presentations and discussions of recent achievements by leading researchers in wavelength shifting luminescence processes (quantum cutting, down-shifting, up-conversion ...). Wavelength SHIFTing lends itself as a very promising route, albeit not yet fully explored, to enable a significant shift to state-of-the-art spectral shaping for biomedical and energy applications.

Since we met the last time at the first edition SHIFT 2017 (Tenerife, 13–17 November 2017), it has been tough years for everyone. Pandemic, lockdowns, war ... but we kept hope. In October 2022, we gathered again at Tenerife to share the best of our science, with an impressive program comprising around 80 universities in 29 countries to meet face-to-face, spend time together and discuss science together again. In fact, SHIFT 2022 also underscored the importance of returning

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to scientific in-person meetings. Scientific conferences have been, and will continue to be, instrumental in the progress of science. It is not only about the talks, the papers published, the posters, the presentations. It is about the personal face-to-face encounters, the discussions during the coffee breaks, at the networking lunches and the gala dinner. It is that brilliant idea or those synergies that could materialize in sharing the Conference lunch during the excursion to El Teide volcano National Park or during a nice walk through the historical UNESCO World Heritage venue city of La Laguna. Unexpected inspiring ideas and connections, new visions and approaches are gestated in those moments. Shining a light on biomedical and energy applications: with new insights into the biomedical field to “cure the people”, and with groundbreaking achievements in renewable energies to “heal the world”, with attention to critical raw materials and strategic minerals as, for example, luminescent and magnetic “rare-earths” elements.

earth” resources. SHIFT 2022 indeed provided an unparalleled forum for fruitful scientific discussions at an outstanding destination, with very prestigious plenary and keynote speakers from Stanford University (USA), Northwestern Univ. (USA), EPFL Lausanne (Switzerland), Univ. Utrecht (Netherlands), Indiana Univ. of Bloomington (USA), Singapore Univ., Univ. Tokyo, CIC-biomaGUNE (Spain), Univ. of Aveiro (Portugal), among others. The SHIFT conference spirit also promotes bridging the gap between young emerging scientists and consolidated researchers. However, attendees did not only represent academia – a number of representatives from industry and government who share common objectives both in terms of fundamental science and commercial applications were also present. Industrial companies could also benefit from special low tax incentives for R + D that the Canary Islands offer, and also as a strategic logistic platform, a tri-continental hub.



Opening ceremony of SHIF2022 at Universidad de La Laguna, Tenerife, with regional and local authorities (10th October 2022).

In detail, shining a light on: wavelength conversion processes (up-conversion, down shifting, TTA (Triplet-Triplet Annihilation), photochemistry, photocatalysis, solar fuels, artificial photosynthesis, plasmonics, photoelectrocatalysis, luminescent solar concentrators, dye-sensitized solar cells, perovskites solar cells, light trapping devices, nanophotonics, anti-counterfeiting, solar lasers, bioimaging, fluorescent bioprobes, nanothermometry, nano-optical sensors, phototherapy, nano-bio interaction, DNA-modified nanoparticles, optogenetics, super-

Thus, the SHIFT indeed happened! Here, we present a collection of papers submitted to this Special Issue by some of the colleagues attending SHIF2022 covering a wide gamut of fields from perovskite solar cells, luminescent solar concentrators, light guides, 3D-printing, photocatalysis, contrast agents for cell imaging among others. We are very much looking forward to shift again in the next edition SHIF2025 (6–10 October 2025), Tenerife, Spain.



Plenary speaker Michael Grätzel addressing lecture at SHIF2022 Conference (Universidad de La Laguna main hall, 10th October 2022).

resolution microscopy, switchable fluorescent proteins, light-gated ion channels and transporter. Not to mention, many other promising and not yet fully explored routes, with an eye on “critical materials” and “rare-



Jorge Méndez-Ramos (Universidad de La Laguna, Tenerife, Spain and SHIFT 2022 Conference Chairman). Received his PhD in 2003 from the University of La Laguna, Spain. After two postdoctoral stays at the Novel Photonics Research Group at University of Nottingham (UK), he backed to University of La Laguna as Lecturer and Researcher from 2004. In 2015, he became Assistant Professor at the Department of Physics at the University of La Laguna. His research focuses on spectral conversion processes in lanthanide-doped luminescent materials for photonics applications. He is the coordinator of the Nanomaterials and Spectroscopy Research Group, where he currently works on applications in photocatalysis, solar fuel generation, water-splitting, artificial photosynthesis. Since 2012, he is also Principal Investigator of MAGEC-REsearch project devoted to materials for energy applications and geological exploration of rare-earth elements (REE) mineral resources in Canary Islands (Spain). General chairman of SHIFT international conference series since 2017.



Luis D. Carlos (University of Aveiro, Portugal). Currently a Full Professor in the Department of Physics, he received his Ph. D. in 1995. He is a member of the Lisbon Academy of Sciences and the Brazilian Academy of Sciences and has held visiting professor positions at the S. Paulo State University, University of Montpellier, and University of Wrocław. In 2000, he founded the research group "Phantom-g" for photonic hybrids and nanomaterials. His research interests include luminescent materials for multiple sensing. He is regarded as an early pioneer and influencer on luminescence (nano)thermometry.



Fiorenzo Vetrone (INRS, Université du Québec, Canada) is Full Professor (Professeur Titulaire). A pioneer in the field of rare earth doped upconverting nanoparticles, he published the first paper in the field and has since made seminal contributions both in their synthesis as well as application. He has given more than 150 invited, keynote, and plenary lectures at prestigious conferences and meetings as well as seminars at universities, research institutions and summer schools around the world. Moreover, he has won several prestigious national and international awards including most recently, the Rutherford Memorial Medal in Chemistry from the Royal Society of Canada for outstanding research in chemistry. He was an elected member of the Global Young Academy and is currently a Member of the College of New Scholars, Artists and Scientists of the Royal Society of Canada, Canada's national system of multidisciplinary recognition for the emerging generation of Canadian intellectual leadership. In 2022, he was named Fellow of the Canadian Academy of Engineering.



Jose Marques-Hueso (Heriot-Watt University, Edinburgh, UK) is Associate Professor at Heriot-Watt University. He completed his Ph.D. degree in Applied Physics with the Optoelectronic Materials and Devices Group, Materials Institute, University of Valencia, in 2011. That year he joined Heriot-Watt University, as a Research Associate to apply photon-managing technologies and spectral conversion materials to solar cells. In 2015, he commenced a position as a Research Fellow using nanomaterials for light-driven manufacturing. In 2017 he became Assistant Professor with the Institute of Sensors, Signals and Systems, and Associate Professor in 2021. His primary field of research is the functional and optical materials, their interaction with light and their translation in advanced applications such as manufacturing and electronics. He led the EPSRC project MUSCLE, in which upconversion multimaterial 3D printing was developed.



Nazario Martín (Universidad Complutense de Madrid, Spain) is Full Professor at University Complutense de Madrid and vice-director of the IMDEA-Nanoscience Institute. He is Doctor h.c. by La Havana university (Cuba) and Castilla La Mancha University (Spain) and member of the Royal Academy of Sciences of Spain (RAC) and corresponding member of the Royal Academy of Doctors of Spain (RADE). His research interests are focused on molecular and supramolecular chemistry of carbon nanostructures in the context of chirality, electron transfer and biomedical and photovoltaic applications. He has published over 600 peer reviewed papers and supervised 50 theses. He has been co-editor of 7 scientific books and guest editor in 14 special issues of important scientific journals. He has been the Editor-in-Chief of the Journal of Materials Chemistry (A, B and C. 2015-19) of the Royal Society of Chemistry (RSC).

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