DIRECT WRITING OF SEMICONDUCTING POLYMER BASED PHOTONIC STRUCTURES WITH OPTICAL MASK-LESS LITHOGRAPHY

Area of Knowledge: Physical Sciences, Mathematics and Engineering
Group of disciplines: Industrial Engineering, Mechanical Engineering, Metallurgy, Materials, Nanotechnology, Aeronautical, Naval and Aerospace Engineering

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RESEARCH PROJECT:
Conjugated polymers (CPs) with high photoluminescence quantum efficiencies (PLQEs) and spectrally broad stimulated emission (SE) cross-sections are attractive gain media for solid-state lasers and optical amplifiers. These and other organic gain media can be pumped by compact laser and light-emitting (LED) diode sources but direct electrical pumping has not been achieved and still remains a major challenge.

Binary blends of conjugated host and guest materials are commonly used to enhance LED performance and to reduce optically pumped laser thresholds via efficient exciton generation on the host and/or guest and rapid host-to-guest FRET. In parallel to these unique light amplifying properties, CPs offers the possibility to be easily solution-processed into films which can be subsequently patterned to achieve flexible polymer-based photonic structures. This has been traditionally achieved by conventional patterning techniques involving mask-assisted photolithography, liquid transfer printing or nanoimprinted lithography.

This project tackles the fabrication of photonic and optoelectronic devices with a new approach which combines high throughput optical mask-less lithography and a new generation of writable CPs with outstanding emission and optical gain properties. Combination of such novel highly fluorescent materials with the unlimited possibilities offered by optical mask-less lithography will open up routes for direct writing of high aspect ratio photonic waveguides, laser resonators with enhanced quality factor, or even post-fabrication processing of LEDs.

JOB DESCRIPTION
What we offer: a PhD position in our group on photophysics and photonic applications of direct writable semiconducting polymers. The PhD program will involve the use of the following techniques:

- Femtosecond transient absorption spectroscopy. This cutting-edge technique will enable to establish a relation between polymer chemical structure, film morphology and stimulated emission properties of the novel polymers.
- Photoluminescence spectroscopy. The emission properties of CPs will be characterized together with assessment of optical gain and losses in waveguides and measurement of thresholds for laser action in cavity resonators.
- Nanopatterning techniques. The candidate will develop photonic structures on the studied CPs with state-of-the-art nanofabrication techniques.
- A range of complementary techniques such as Raman spectroscopy, optical and electron microscopy or atomic force microscopy available at IMDEA are expected to be used.
The candidate will be integrated in a friendly and motivated research team, having the possibility to acquire skills on a broad range of techniques for materials inspection, publish his work on highly reputed scientific journals and disseminate the acquired knowledge in international events around the world.

What we require: we look for highly motivated candidates with a background in physics, chemistry or related engineering who are willing to work in a dynamic team. Knowledge in the field of optics will be appreciated. Computer skills and software programming in Labview, Python or C++ will also be of interest but not mandatory.

MORE INFORMATION:
Group Website: [http://nanociencia.imdea.org/home-en/people/item/juan-cabanillas-gonzalez](http://nanociencia.imdea.org/home-en/people/item/juan-cabanillas-gonzalez)
Other info: [https://juancabanillas.wixsite.com/research](https://juancabanillas.wixsite.com/research)

CENTRE INFO:
IMDEA Nanociencia Institute

[www.nanociencia.imdea.org](http://www.nanociencia.imdea.org)

IMDEA Nanociencia is a young interdisciplinary research centre dedicated to the exploration of basic nanoscience and the development of applications of nanotechnology in connection with innovative industries.

Our purpose-built building was inaugurated in 2014 and features state-of-the-art facilities for 21st century science, where the frontiers between fields disappear and Physics, Chemistry, Biology, Engineering, and Medicine merge. It features more than 30 operative laboratories with over € 16 M worth of equipment –including the Centre for Micro and Nanofabrication. We are located at the UAM Campus, with access to all the facilities of one of Spain’s largest and most prestigious Universities. The UAM Campus is just a few minutes away from Madrid’s lively city centre, connected by “cercanías” trains and several bus lines.

We are over 180 scientists, with different professional and personal backgrounds. Approximately 40% of our PhD and postdocs come from outside Spain, representing every corner of the world, from Germany to China, from the USA to Singapore –a true international environment in which to develop your scientific career. Women make up 45% of our scientific and 60% of our management staff. No matter who you are or where you come from, you will feel welcome from the very first minute.

We take science seriously and value quality over quantity. Our scientists enjoy tackling complex multidisciplinary problems, often within in-house collaborations, so all of our students receive truly interdisciplinary training. We also enjoy publishing in the very best journals, with >200 publications a year, and an institutional h index of 90. Check out our [webpage](http://www.nanociencia.imdea.org), facebook [@IMDEANanociencia](https://twitter.com/IMDEANanociencia) or twitter [@IMDEA_Nano](https://twitter.com/IMDEA_Nano) for more information.

So if you are a talented, hard-working individual with a real interest in Science, IMDEA Nanociencia is the right place for you! Come work with us!