

Marie-Skłodowska-Curie Actions – Postdoctoral Fellowships 2025

INL Expression of Interest

Research Group Leader /Research Group name:	
Jana Nieder/Nieder group on Ultrafast Bio- and Nanophotonics	
Scientist in charge:	
Name & surname	Jana Nieder (PICs for biosensing) / Bruno Romeira (PICs for neuromorphics) / Christian Maibohm (3D interconnects and micro-optical elements)
Contact email	Jana.Nieder@inl.int
Short description of the research group, including URL if applicable (<i>Strengths and scientific achievements (publications, patents, etc.), important infrastructure (up to 2000 characters with spaces)</i>):	
<p>Nieder's group explores light-matter interactions and control within three primary domains. Firstly, advanced bioimaging and sensing involves the use of nanofunctionalised surfaces and particles with ultrafast laser technology to achieve innovative imaging and sensing capabilities in terms of resolution and multi-parameter functional imaging. The group collaborates with researchers and innovators to apply novel techniques for therapeutic advancements or enhanced diagnostic tools. Secondly, in quantum photonics, the focus is on comprehending and using the emission of single quantum emitters in 2D materials or 3D crystals. These emitters could play a pivotal role if seamlessly integrated into controllable photonic platforms. Finally, the emphasis in photonic integrated devices is on developing photonic integrated chips and advanced characterisation tools to provide new paradigms in neuromorphic and quantum computation, while also enabling nanotechnologies for biosensing and quantum information technologies.</p>	
Project title:	
Advances in Integrated Photonics	
Project description (<i>up to 2000 characters with spaces</i>):	
<p>In frame of the new project APECS, a pilot line for heterogenous integration, we will develop chiplets for photonic technologies, some that might benefit from complementary and more exploratory research and testing of new concepts and exploratory applications in frame of an individual fellowship.</p> <p>Topics can be proposed in these or related areas:</p> <p>The development of PICs for (Bio-) Sensing, e.g. via detection of interference effects upon changes of the refractive index in the chips environment. This might include research that integrates microscale light sources and detectors, with 2D and 3D waveguides and interconnects and tests the chips with biomimicking or relevant biological solutions.</p> <p>Our group has strong expertise in the scientific area of neuromorphic photonics where we explore novel spiking nanoscale LED and photodetector semiconductor chips as the key building blocks of bioinspired light-based photonic computational platforms. Projects that explore advanced integration of these sources/detectors or optimization of their optoelectronic</p>	

properties and signal processing could be relevant project components.

Projects can also focus on the **optimization and testing of novel 3D microfabrication** setups and methods available or developed at INL, and development novel approaches to on-chip and chip-to-chip interconnections and light guiding, e.g. via 3D interconnects or micro-optical elements. We will receive new fs laser source and two photon polymerization (TPP) microfabrication equipment, and the candidate can be involved in novel design and fabrication of photonic elements that can be fabricated with 3D microfabrication. From light-guiding structures that may be used in various contexts from the interconnection of light sources in neuromorphic photonic platforms, to the interconnection of single photon emitters, or interconnects that funnel light into 3D in vitro models for advanced bioimaging and sensing applications.

Based on the background and interest of the candidate we are eager to co-develop a winning MSCA application, that meets the candidate's strength as well as opportunity in career growth.

Related references by the research group and in collaboration with INL internal and external researchers:

PICs for sensing applications

Fernando J. Gordo, Joana Tátá, Jérôme Borme, Morten A. Geday, Manuel Caño-García, and Jana B. Nieder, "Design and manufacture of an all-polymeric integrated multimode interferometer for visible photonics," *Opt. Express* 30, 31147-31156 (2022)

Tiago E.C. Magalhães*, Jérôme Borme, Temple Douglas, Christian Maibohm and Jana B. Nieder, Design and fabrication of asymmetric Mach-Zehnder interferometers based on EpoClad and EpoCore strip waveguides, *EPJ Web Conf.* Volume 305, 2024, 6th International Conference on Applications of Optics and Photonics (AOP2024), <https://doi.org/10.1051/epiconf/202430500028>

Spiking nanolight sources for neuromorphic applications

Jacob, B., Silva, J., Figueiredo, J.M.L. *et al.* Light-induced negative differential resistance and neural oscillations in neuromorphic photonic semiconductor micropillar sensory neurons. *Sci Rep* **15**, 6805 (2025). <https://doi.org/10.1038/s41598-025-90265-z>

Bejoys Jacob, João Azevedo, Jana B. Nieder, and Bruno Romeira, "Electroluminescence in n-type GaAs unipolar nanoLEDs," *Opt. Lett.* 50, 1101-1104 (2025)

Bejoys Jacob, Filipe Camarneiro, Jérôme Borme, Oleksandr Bondarchuk, Jana B. Nieder, and Bruno Romeira, *ACS Applied Electronic Materials* **2022** 4 (7), 3399-3410, DOI: 10.1021/acsaelm.2c00195

Perspective

Bruno Romeira, Ricardo Adão, Jana B Nieder, Qusay Al-Taai, Weikang Zhang, Robert H Hadfield, Edward Wasige, Matěj Hejda, Antonio Hurtado, Ekaterina Malysheva, Victor Dolores Calzadilla, João Lourenço, D Castro Alves, José M L Figueiredo, Ignacio Ortega-Piwonka, Julien Javaloyes, Stuart Edwards, J Iwan Davies, Folkert Horst and Bert J Offrein, Brain-inspired nanophotonic spike computing: challenges and prospects, *Neuromorph. Comput. Eng.* **3** 033001, 2023, DOI 10.1088/2634-4386/acdf17

3D interconnects and TPP

Ricardo M. R. Adão, Tiago L. Alves, Christian Maibohm, Bruno Romeira, and Jana B. Nieder, "Two-photon polymerization simulation and fabrication of 3D microprinted suspended waveguides for on-chip optical interconnects," *Opt. Express* 30, 9623-9642 (2022)

A. Andrishak, T. L. Alves, R. M. R. Adão, C. Maibohm, B. Romeira, and J. B. Nieder, "3D Polymer Interconnects for Neuromorphic Photonics Technologies," in Conference on Lasers and Electro-Optics/Europe (CLEO/Europe 2023) and European Quantum Electronics Conference (EQEC 2023), Technical Digest Series (Optica Publishing Group, 2023), paper jsiip_p_2.

Maibohm, C., Silvestre, O.F., Borme, J. *et al.* Multi-beam two-photon polymerization for fast large area 3D periodic structure fabrication for bioapplications. *Sci Rep* **10**, 8740 (2020). <https://doi.org/10.1038/s41598-020-64955-9>

Research fields (*You may choose more than one*)

Chemistry (CHE)	X	Life Sciences (LIF)	X
Economic Sciences (ECO)		Mathematics (MAT)	
Environment and Geosciences (ENV)		Physics (PHY)	X
Information Science and Engineering (ENG)	X	Social Sciences and Humanities (SOC)	

Expiration date for Expressions of Interest from postdoctoral fellows:

4 weeks before
the MSCA
application
deadline

Necessary documents to be submitted (in addition to the required CV and motivation letter):

A research statement that connects the candidate's expertise with a "**Advances in Integrated Photonics**" related project.