MARIE SKŁODOWSKA-CURIE POSTDOCTORAL FELLOWSHIPS 2021

EXPRESSION OF INTEREST FOR HOSTING MARIE CURIE FELLOWS

HOST INSTITUTION

NOVA University Lisbon | School of Science and Technology

RESEARCH GROUP AND URL

CENIMAT/I3N
https://www.cenimat.fct.unl.pt/

SUPERVISOR (NAME AND E-MAIL)

Jonas Deuermeier
j.deuermeier@fct.unl.pt

SHORT CV OF THE SUPERVISOR

Jonas Deuermeier holds a joint doctoral degree from the Universidade Nova de Lisboa, Portugal and the Technische Universität Darmstadt, Germany as a result of a collaborative PhD project under co-supervision by Prof. Elvira Fortunato and Prof. Andreas Klein. Currently, he is responsible for X-ray and ultravoilet photoelectron spectroscopy (XPS/UPS) at CENIMAT/I3N. The central theme of his research is the correlation of interface properties with electrical device behavior, with a strong emphasis on oxide semiconductors. Recently, his main output has been the development of novel self-rectifying resistive switching devices, which are controlled by chemical and electronic interactions at interfaces. In an ongoing PhD thesis under his supervision, a simulation framework is developed for the quantitative study of facetted and multilayered micro/nanoparticles by photoelectron spectroscopy. As evidence by his full publication record, he is maintaining a dense network of collaborations on the European level (Germany, France, Norway, Finland).

5 SELECTED PUBLICATIONS

- “Design and synthesis of low temperature printed metal oxide memristors”, E. Carlos, J. Deuermeier, R. Branquinho, C. Gaspar, R. Martins, A. Kiazadeh, E. Fortunato, *Journal of Materials Chemistry C* **2021**, *9*, 3911, http://doi.org/10.1039/D0TC05368F.

- “Noble-Metal-Free Memristive Devices Based on IGZO for Neuromorphic Applications”, M. Pereira, J. Deuermeier, R. Nogueira, P. A. Carvalho, R. Martins, E. Fortunato, A. Kiazadeh, *Advanced Electronic Materials* **2020**, *6*, 2000242, http://doi.org/10.1002/aelm.202000242.

- “2D Resistive Switching Based on Amorphous Zinc–Tin Oxide Schottky Diodes”, N. Casa Branca, J. Deuermeier, J. Martins, E. Carlos, M. Pereira, R. Martins, E. Fortunato, A. Kiazadeh, *Advanced Electronic Materials* **2020**, *6*, 1900958, https://doi.org/10.1002/aelm.201900958.

- “Flexible and transparent ReRAM devices for system on panel (SOP) application”, A. Kiazadeh and J. Deuermeier, in *Advances in Non-Volatile Memory and Storage Technology* (Eds.: Y. Nishi, B. Magyari-Kope), Woodhead Publishing, **2019**, pp. 519–538., https://doi.org/10.1016/B978-0-08-102584-0.00014-0.

- “Energy band alignment at the nanoscale”, J. Deuermeier, E. Fortunato, R. Martins, A. Klein, *Applied Physics Letters* **2017**, *110*, 051603, http://doi.org/10.1063/1.4975644.

PROJECT TITLE AND SHORT DESCRIPTION

Supreme-IT: Sustainable Printed Memristors by Interface Tuning

Inherent memory properties are widely used in nature for several aims. Brains retrieve/store data in synaptic connections, whereas information stored in computers requires a complex circuit. Being considered artificial synapses, memristors promise nothing less than a revolution in computation. For artificial intelligence applications such as pattern recognition, memristor-based systems have proven to be orders of magnitude more energy-efficient than Von Neumann architectures. With the new era of electronic devices for Internet-of-Things (IoT) applications and wearables arise a need to explore key-enabling technologies such as printing to produce customized devices on demand and in large quantities. A relatively cheap memristor technology is based on transition metal oxides, which can be fabricated on unconventional substrates presenting sustainable options for such applications. Recently, memristors printed from solution have shown promising performance with versatile manufacturing possibilities without the need of substrative processes reducing the associated costs and carbon footprint. However, solution-processed devices which meet the requirements for artificial synapses (analog control over multiple resistance levels) are still scars and most of the printed memristors work with an electrochemical mechanism (ECM), employing silver or copper electrodes. Furthermore, the implementation into passive crossbar arrays requires a self-rectifying resistive switching device. Previously, our group has revealed this type of switching behavior in devices based on zinc-tin oxide Schottky diodes, fabricated with the comparatively costly physical vapor deposition (PVD) technique. Self-rectifying memristors are yet to be developed via inexpensive printing routes.

This project aims to develop fully printed, self-rectifying memristors, entirely free of noble and critical raw materials. To achieve the necessary control over the chemical and electronic properties at the Schottky interface, a “close to in situ” approach for X-ray photoelectron spectroscopy of solution processed thin films will be explored. This is a novelty in terms of device engineering methodology for solution processed electronics. The proposed device structure will be entirely printable and optimized for future easy patterning of crossbar arrays, to allow immediate exploitation or the predicted results of this project.

SCIENTIFIC AREA WHERE THE PROJECT FITS BEST*

Chemistry (CHE)