Univ. Grenoble Alpes
Université de l'innovation

SUBJECT TITLE: ***Stable p-i-n solar cells using metal halide perovskites***

RESEARCH FIELD: perovskite solar cells, inverted structure, hysteresis
SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): CEA Grenoble INAC-SyMMES-STEP
DOCTORAL SCHOOL'S: EDCSV
SUPERVISOR'S NAME*:* Dr. Peter REISS, Prof. Elisabeth DJURADO

SUBJECT DESCRIPTION:
The main goals of this project are to develop novel methods for the preparation of NiO based photoelectrodes of precisely controlled doping level and microstructure using the electrostatic spray deposition (ESD) technique and to apply them in metal halide perovskite solar cells.

Context:
Perovskite solar cells are an unprecedented phenomenon in photovoltaics research: within only a few years power conversion efficiencies exceeding 23% have been reported, placing them at the same performance level as established Si-based and thin-film technologies. However, among other aspects, problems related to their insufficient stability under irradiation and to their composition, comprising toxic lead, have to be urgently addressed. In this highly competitive field we propose a completely new approach for the preparation of nanostructured p-type photoelectrodes with the goal to substantially improve the stability of hybrid perovskite solar cells by using a p-i-n configuration, i.e. solar light is absorbed through the transparent p-type photoelectrode. This configuration shows a number of advantageous features with respect to the widely used n-i-p configuration, based on the use of n-type TiO_2 or ZnO in the front photoelectrode: negligible hysteresis in the I/V characteristics (i.e. the measured performance does not depend on the voltage scan direction), as well as absence of an organic hole-transport material and of photocatalytic TiO_2, both of which are expected to severely limit device stability. NiO has been identified as the most promising candidate for elaborating nanostructured inorganic photoelectrodes using the electrostatic spray deposition (ESD) technique. This technique gives access to a large palette of microstructures and allows the precise control of the doping level of NiO. In preliminary studies we have already demonstrated that Cu^+ doping results in a significant change in the morphology of the perovskite layer deposited on top yielding improved solar cell performances. In this project we want to fully exploit the potential of ESD for synthesizing NiO layers of controlled microstructure and porosity, generating novel types of versatile photoelectrodes. The obtained photoelectrodes will also be evaluated in combination with lead-free perovskites, in dye-sensitized solar cells as well as in photocatalysis.

Role of the candidate:
The PhD candidate will split his/her time between the two partner teams at CEA-Grenoble/INAC/SyMMES-STEP and at UGA/LEPMI/MIEL to realize the following tasks:
- Preparation of different doped and undoped NiO nanostructures at LEPMI
=> The microstructure and the electrical conductivity should be optimised for the use in perovskite solar cells. The candidate will also carry out the structural characterization of the obtained materials by FEG-SEM, FEG-TEM at LEPMI and X-ray diffraction at SyMMES-STEP.
- Solar cell fabrication and characterisation at SyMMES-STEP
=> The deposition parameters of the perovskite and electron transport layers have to be optimised and different types of hybrid perovskites will be tested. The I/V and IPCE characteristics will be measured and their evolution under accelerated ageing conditions will be investigated. Based on the obtained results, the candidate will suggest and implement improvements in the NiO preparation and solar cell fabrication
- Evaluation of the performance of the obtained photoelectrodes in dye-sensitized solar cells, as well as in photocatalysis, benefiting from existing collaborations.

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ELIGIBILITY CRITERIA

Applicants:
- must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration),

Applicants will have to send an application letter in English and attach:
- Their last diploma
- Their CV
- A short presentation of their scientific project (2 to 3 pages max)
- Letters of recommendation are welcome.

Address to send their application: peter.reiss@cea.fr & elisabeth.djurado@lepmi.grenoble-inp.fr

SELECTION PROCESS

Application deadline: **June 15 2018** at 17:00 (CET)
Applications will be evaluated through a three-step process:

1. Eligibility check of applications by June 20, 2018
2. 1st round of selection: the applications will be evaluated by a Review Board in the second half of June 2018. Results will be given by June 29, 2018.
3. 2nd round of selection: shortlisted candidates will be invited for an interview session in Grenoble in the beginning of July 2018. (if necessary)

TYPE of CONTRACT: temporary-3 years of doctoral contract
OFFER STARTING DATE: October 1st, 2018
APPLICATION DEADLINE: June 15, 2018
Monthly gross salary: 1800-2100 €

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SECTOR **:** Higher Education Institution

LOCATION: France, Grenoble

RESEARCHER PROFILE:

□ *First stage researcher*

INSTITUTION: Univ. Grenoble Alpes, University of Innovation

One of the major research-intensive French universities, Univ. Grenoble Alpes**[1] enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments (ESRF, ILL, EMBL, IRAM, EMFL*2). The vibring ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alps is an internationally engaged university.

A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation.

In 2016, Univ. Grenoble Alpes was labeled «Initiative of Excellence ". This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century ("sustainable planet and society", "health, well-being and technology", "understanding and supporting innovation: culture, technology, organizations" "Digital technology").

* ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), IRAM (International Institute for Radio Astronomy), EMBL (European Molecular Biology Laboratory), EMFL (European Magnetic Field Laboratory)

Key figures:

- + 50,000 students including 7,000 international students
- 3,700 PhD students, 45% international
- 5,500 faculty members
- 180 different nationalities
- 1st city in France where it feels good to study and 5th city where it feels good to work
- ISSO: International Students & Scholars Office affiliated to EURAXESS

[1] Univ. Grenoble Alpes