POSTDOCTORAL RESEARCH POSITION (12 months) AT UCCS
(CNRS UMR 8181/University of Artois-France)

Nanoscale Advanced Electrical Characterization of Piezoelectric Composites by Atomic Force Microscopy

This position is offered by the Unit of Catalyst and Solid State Chemistry (UCCS) at the University of Artois (Lens-France) within the Thin-films-and-Nanomaterials team (http://www.uccs.univ-artois.fr/). The work settles within the framework of the NanoPiC project (Study of multi-scale piezoelectric behavior of innovative micro- and nano-structured composites) funded by the National Research Agency (ANR) in partnership with UMET/Lille, IEMN/Lille-Valenciennes, ICGM/Montpellier and UCCS/Lens (http://nanopic.univ-lille.fr/). The supervisors at UCCS will be Pr. Rachel Desfeux, Dr. Anthony Ferri and Dr. Antonio Da Costa. A detailed project overview may be found below.

Job description

The post-doc researcher will directly be involved in the nanoscale electrical characterization by Atomic Force Microscopy (AFM) of piezoelectric/ferroelectric thin films, polymers and nano-structured ceramic-polymer composites. She/He will investigate domain-patterns, switching properties, electromechanichal properties, local electrical-conductivity… of samples by advanced electrical techniques/tools of AFM, mainly including Piezoresponse Force Microscopy (PFM) and Conductive AFM (c-AFM). The candidate will interact and collaborate with the consortium teams of the NanoPiC project.

Candidate profile/Required competences:

We seek a candidate with a PhD degree in a subject of relevance for conducting the project (Materials Science, Solid State Chemistry, Condensed Matter Physics….). The candidate will have a strong experimental experience in Atomic Force Microscopy. Preference will be given to applicants having experience in electrical modes of AFM. Backgrounds in ferroelectrics, related macroscale electrical measurement methods, fabrication processes, structural, chemical, physical characterizations of thin films or/and polymers will be appreciated. The candidate should have good communication skills to interact with the project partners. She/He should speak English or French with the ability to write well-organized papers in English.

How to apply: send your complete application form including CV, cover and recommendation letters, list of publications and copies of the relevant degrees to the contact below.
Deadline for application: June 1, 2019
Start date: September 1, 2019
Contract period: one year *(temporary position of 12 months - Contract type: full time)*
Workplace: UCCS (CNRS UMR 8181), Université d'Artois, Faculté des Sciences Jean Perrin, Rue Jean Souvraz, 62307 Lens, France
Remuneration: around 2270 € net monthly
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Contact: Prof. Rachel Desfeux, University of Artois, E-mail: rachel.desfeux@univ-artois.fr, Tel: +33(0)321791771

NanoPiC project

NanoPiC project aims at creating innovative piezoelectric materials with enhanced properties, from ceramic-polymer structured composites. The structuration at different scales (from micron to nanometer) will be performed by thin film etching of $Bi_{0.5}Na_{0.5}TiO_3$ (BNT) ceramic. The choice of these ceramics is based on the twofold aspect of non-toxicity (lead free) and the high piezoelectric properties (d_{33} = 80/120 pm.V^{-1}). The passive or active fluorinated polymer poly(vinylidene fluoride) (PVDF) or its copolymer with trifluoroethylene (P(VDF-TrFe)) will be incorporated by grafting from ceramic surfaces in order to increase the interfacial cohesion between the two materials. In polar crystalline phase, the fluoropolymers present the advantage to have a high piezoelectric coefficient compared to other polymer materials (d_{33} = -20/30 pC.N^{-1}). The combination of processes such as ceramic etching and polymer grafting for the fabrication of structured composites is an original and innovative approach.

In the case of PVDF, the structuration of domains from microns to nanometers present a high interest on the polymer crystalline structure and may imply a phase change (no polar/polar) induced by the confinement. The polymer initially passive can then become active.

The piezoelectric characterization of composites will be investigated at the macroscopic scale in order to probe the global piezoelectric answer of the material. In this case, the electrode topology will have a key role and will allow a parallel or anti-parallel poling of ceramic or polymer domains, i.e. a compensation or addition of piezoelectric properties. In addition, local piezoelectric properties will be performed by PFM (Piezoelectric Force Microscopy) to evaluate the impact of the size (micro- or nano-metric domains) and of the environment (for instance in the case of ceramic domain, the influence of passive or active polymer incorporation, influence of grafting...) of ceramic and polymer domains on the piezoelectric performances. The understanding of multi-scale piezoelectric behaviors of these structured composite materials is simultaneously a fundamental scientific challenge, and an innovative means to widen the scope of utilization of these materials for applications in pMUT (piezoelectric Micro machined Ultrasonic Transducers) area.

Consortium (4 partners) gathers teams from:

i) Materials and Processing Unit (UMET/Lille): strong expertise on the structure and properties of composites based on piezoelectric polymer matrix,

ii) Institute of Electronics, Microelectronics and Nanotechnology *(IEMN/Lille-Valenciennes)*: strong expertise on the growth of functional ceramic materials like ferroelectric and piezoelectric films and facilities to fabricate micro-/nano-structures,

iii) Institute Charles Gherardt Montpellier (ICGM/Montpellier): expertise in the controlled radical polymerization of fluorinated polymers and in the properties of composites based on piezoelectric polymer matrix),

iv) Unit of Catalyst and Solid State Chemistry (UCCS/Lens): strong expertise in the nanoscale characterization of piezoelectric/ferroelectric thin films and nanostructures.