POST- DOCT OFFER – 1 YEAR- IMS/ICMCB Bordeaux

Low temperature sintering of printed piezoelectric lead free $(K,Na)NbO_3$ layers supported on polymer substrates: towards flexible composite piezoelectric energy harvester.

Context: Piezoelectric cantilevers structures are widely studied for vibration energy harvesting due to the simplicity of the electro-mechanical conversion. Among process technology to integrate piezoelectric materials on these cantilever, ceramic thick films deposited on metallic substrates are attractive (i) to avoid pre-thinning of a piezoceramic then bonded on the substrate, (ii) to get higher power than in the case of thin films, and (iii) to achieve better flexibility than with silicon substrates. Even if lead-based perovskite materials such as $Pb(ZrTi)O_3$ (PZT) are still largely investigated because of unrivalled properties, researches are currently focusing on environmentally friendly materials and more flexible generators. $(KNa)NbO_3$ (KNN) lead-free perovskites already showed promising results in both film or ceramic form. Another actual trend is to increase the flexibility of the generators. Polymers, nanomaterials or nanomaterials embedded in composites with controlled shaped and orientation are a current option for stretchable generators in wearable or Internet Of Things applications.

Objectives: In a context of energy consumption reduction and sustainability, the post-doc will focus on the low temperature sintering of lead-free piezoelectric ceramic on flexible substrate targeting energy harvesting applications. The lead free ceramic perovskite $(KNa)NbO_3$ will be used. Low temperature (<800°C) sintering processes such as SPS will be explored as a route to obtain multilayer composite components made of screen-printed ceramic thick films deposited on flexible substrates. The process temperature will depend on the substrate choice, metallic or polymer (< 500°C when using polymer substrate).
The main objectives of this post-doc position will be:

1. ***Process implementation for the assembly of the substrate/electrode/KNN/electrode stack***:
   1.1. Screen-printing pastes choices and/or formulation
   1.2. Screen-printing of the electrodes and KNN layers,
   1.3. Co-sintering by SPS: design of specific mold, optimization of sintering conditions: temperature, pressure and atmosphere. SPS sintering of disks will classical SPS molds will help to define the sintering conditions of the printed KNN layer.
2. ***Control of KNN microstructure (porosity and grain boundary) and of the multilayer interfaces (substrate/electrode and electrode/KNN)***; optimization of the process if needed.
3. ***Characterization of dielectric/piezoelectric properties*** of the screen-printed KNN in relation with its microstructure will be finally done.

Expected profile: Sintering experience especially SPS, structural and microstructural characterizations (XRD, SEM); knowledge in printing technologies and characterizations of ferroelectric materials will be appreciated.

Hosting Laboratories:
- IMS (PRIMS team www.ims-bordeaux.fr/fr/recherche/groupes-recherche/58-organique/prims/41-PRIMS and TAMIS facilities (www.ims-bordeaux.fr/fr/plateformes/centrales-de-technologies/46-tamis))
- ICMCB (group 1 www.icmcb-bordeaux.cnrs.fr/groupes/groupe1/ and Sintering SPS facilities https://www.icmcb-bordeaux.cnrs.fr/en/facilities/)

Candidate's selection in April, Monthly gross salary~ 2600 €

Contact: send CV to

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