Post-doctoral Position in Experimental Physics
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Local electronic properties of a remarkable ionic conductor

Keywords: Ionic conductors, Supercapacitors, Magnetism, NMR, EPR

Laboratory: LPEM (ESPCI Paris / CNRS / PSL Univ. / Sorbonne Univ.), Paris, France
http://www.lpem.espci.fr/spip.php?rubrique45

Description: The 2D oxides $M_2Ti_2O_5$ (M=Rb, K) have demonstrated remarkable properties, with the association of a colossal low-frequency dielectric constant ($\simeq 10^9$) and an exceptional electric polarization (0.1 C/cm^2). These effects are linked to the very large ionic conductivity of the material and to the accumulation of charges at its boundaries [1]. While this material is promising for energy (super-capacitors) and charge (memory) storage, the microscopic description and mechanisms are not well understood: impact of ionic diffusion on the electronic properties, spatial variations of the latter when polarizing the sample, transport properties of the diffusing ionic species (activation, temperature dependence)...

In the context of the "MIMETIX" ANR project federating several French labs (LPEM Paris, ICCMO Orsay, IMPMC Paris...), we aim at understanding the local electronic properties of these materials using NMR (Nuclear Magnetic Resonance) and EPR (Electron Paramagnetic Resonance), two highly-sensitive probes at the nano-scale [2]. Previously, we have observed possible evidence of the diffusing species altering the magnetism of the Ti/O layers, pointing at a more complicated scenario than simple ionic diffusion [3]. The current objectives are (i) to study the presence of localized electrons in the Ti/O layers and their correlation (lifetime) with ionic diffusion using EPR of magnetic impurities (ii) to probe the local metallicity in electrically-polarized samples featuring a "virtual cathode" using NMR (iii) based on evidence of dissociated water molecules inside the crystal, to determine with NMR the different populations of hydrogen nuclei (diffusing/trapped OH^- and H^+ ions) and establish their sensitivity to hydration and electrical polarization.

The candidate will join the ELEMAG team (https://em.lpem.espci.fr/home/) and work under the supervision of G. Lang. They will be in charge of planning and performing the EPR and NMR studies, in close connection with other members of the MIMETIX project, in particular sample growers. They will have the possibility to participate in studies involving other techniques, as well as in the commissioning of a new NMR setup to be delivered during the postdoctoral stay. The position should start in September 2024 for a one-year duration.

[1] R. Federicci, Ph.D. thesis, UPMC (2016)
[2] Sheina *et al.*, Communications Physics 6, 135 (2023) - https://hal.science/hal-04236984v1
[3] de Sousa Coutinho *et al.*, Solid State Ionics 364, 115630 (2021) - https://hal.science/hal-03377781v1

Prerequisites: Ph.D. in experimental physics (condensed matter). While a plus, prior EPR/NMR experience is not mandatory.

How to apply: Send a CV including a list of communications and at least one recommandation letter to guillaume.lang@espci.fr.