Postdoctoral Scholar Position in the POM team at UPMC-Université Paris 06

Layered Polyoxometalate materials for molecular electronics

Description

Polyoxometalates (POMs) obeying to the general formula $[X_xM_pO_y]^{n-}$ (X= P, Si …; M = Mo^{VI}, W^{VI}, V^{V}…) are nano-sized early transition metal oxide clusters which bridge the gap between common molecules and extended oxides. They display a wide variety of compositions, sizes and shapes, and exhibit a range of properties that are unique in their combination. We are especially interested in their remarkable redox properties and their integration as electro-active molecules in nano-electronic devices. This requires the immobilization of POMs onto appropriate substrates (electrodes) and the investigation of the redox-switching abilities of the resulting layered POM-based materials.

The project comprises two complementary parts:

- controlling the interface between the immobilized POMs and the substrate through a covalent approach. Following previous examples reported in the team of A. Proust about the covalent immobilization of diazonium-terminated Keggin-type POM hybrids,[1-3] other types of POMs will be synthesized, organically-functionalized and subsequently grafted onto various supports. Depending on the choice of the starting POM building block, mono- or multi-layer materials will be obtained and further characterized by current/voltage measurements. This part aims at a fundamental understanding of the electron transport mechanisms and the influence of both the energy level alignment and the organization of the POM layers on the final electrical properties.[4]
- integrating POMs as active nodes in original nano-electronic devices devised for bio-inspired computing. This part aims at screening the potentialities of various families of POMs, of different sizes and electronic states. Since shape-processing is not the primary goal in this part, electrostatic deposition of the selected POMs on pre-assembled devices will be considered.

The project thus involves the team of Anna Proust at the Parisian Institute of Molecular Chemistry in Paris (IPCM) for the synthesis of pristine and functionalized POMs and their covalent immobilization (http://ipcm.fr/nouvelle-traduction-1-presentation-742?lang=en), and the team of Dominique Vuillaume at the Institute for Electronics, Microelectronics and Nanotechnology (IEMN) in Lille for the electrical characterization and elaboration of POM based nano-electronic devices (http://ncm.iemn.univ-lille1.fr).

Qualifications: Doctoral degree in Inorganic or Materials Chemistry. A background in polyoxometalate synthesis will be appreciated but not discriminative. The candidate should be motivated by surface chemistry and ready to commit him(her)self in the electrical characterization of the materials during several stays at IEMN (Lille is 1h by train from Paris).

To apply: Please send a single pdf file containing a cover letter, curriculum vitae, and the names of two references to anna.proust@upmc.fr

Start date January- February 2017 – 1 year
Stipend about 2400 € (gross wage)

1. Rinfray, C.; Izzet, G.; Pinson, J.; Derouich, S. G.; Ganem, J. J.; Combellas, C.; Kanoufi, F.; Proust, A., Electrografting of Diazonium-Functionalized Polyoxometalates: Synthesis, Immobilisation and Electron-Transfer Characterisation from Glassy Carbon. *Chem-Eur J* **2013,** *19* (41), 13838-13846.

2.Volatron, F.; Noel, J. M.; Rinfray, C.; Decorse, P.; Combellas, C.; Kanoufi, F.; Proust, A., Electron transfer properties of a monolayer of hybrid polyoxometalates on silicon. *J Mater Chem C* **2015,** *3* (24), 6266-6275.

3. Huder, L.; Rinfray, C.; Rouchon, D.; Benayad, A.; Baraket, M.; Izzet, G.; Lipp-Bregolin, F.; Lapertot, G.; Dubois, L.; Proust, A.; Jansen, L.; Duclairoir, F., Evidence for Charge Transfer at the Interface between Hybrid Phosphomolybdate and Epitaxial Graphene. *Langmuir* **2016,** *32* (19), 4774-4783.

4. Laurans, M.; Volatron, F.; Izzet, G.; Proust, A.; Guerin, D.; Vuillaume, D.; Lenfant, S., Covalent Grafting of Polyoxometalates onto Silicon: Toward Molecular Electronic Devices *8th International Conference on Molecular Electronics, Paris, France 22-26 August* **2016**.