PhD position in Solid State Coordination Chemistry (2020-2023)

Phase Change Coordination Polymers for Molecular Memory

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A three years PhD fellowship is proposed at Lyon University, France, for an exceptional candidate to conduct leading edge research in the new and existing domains of phase change coordination polymers and molecular memory. This is an international French-Japanese research project with Pr. Satoshi Horike from Institute for Integrated Cell-Material Sciences (iCeMS) at Kyoto University, Japan.

Every day, we create 2.5 quintillion (2.5 10^{30}) bytes of data, so much that 90 % of the data in the world today has been created in the last two years alone. The potential discovery of a universal memory that exhibits fast access speed, high-density storage, and non-volatility has fueled research into Phase-Change Random Access Memory (PCRAM) with the class of chalcogenide phase-change materials. The process of rapid phase change involved in the writing and erasing of data in optical recording is presently induced by a purely thermal process using nanosecond laser pulses: heating of the material leads to the formation of a molten phase and subsequently the crystalline (SET) or amorphous (RESET) state, depending on the cooling speed. Then the reading utilizes the difference of the two phases in electric resistivity and refractive index. Although chalcogenides have some limitations, regarding the cyclability, the temperatures of crystallization-amorphization, the roughness, they are almost the only phase-change materials tested for PCRAM. To overcome the physical limitations of these inorganic solids, we have developed new hybrid materials that are **Multifunctional Phase Change Coordination Polymers (PCCPs)** to be studied as new PCRAM.

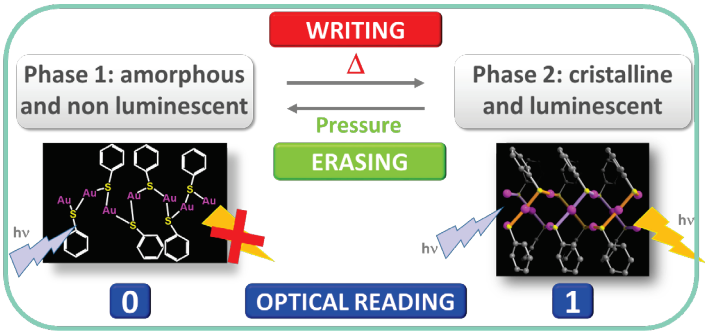

Figure 1. Example of a PCCP: the 1D $[Au(SPh)]_n$.

Based on the first discovered PCCPs, such as $[Au(SPh)]_n$, which exhibits a turn on/off of the emission upon heating/pressure, related to the crystallization/amorphization process (Fig. 1A),[1] the candidate's objectives will be to develop new multifunctional PCCPs. d^{10} Metal Organic Chalcogenolates $[M(ER)]_n$ with M = Cu(I), Ag(I), Au(I) and different functional chalcogenolate ligands (E = S or Se) will be studied to generate multifunctional PCCPs with physical properties, like photoluminescence or conductivity.[2] The new compounds will be fully characterized in their crystalline and amorphous phases by different techniques

(PXRD, PDF, TGA, DSC, FT-IR, XPS, EXAFS, solid state NMR….) as well as their physical properties (photoluminescence and conductivity). The phase transition kinetics and thermodynamics will also be investigated. The formation of thin films will be finally carried out to get nanostructured devices for the memory application tests.[3] This interdisciplinary project represents a new strategy towards the design of innovative PCRAM and provides an opportunity to develop both novel functional and nanostructured hybrid materials.

The ideal candidate for this Ph.D. degree should have a strong background in coordination chemistry and crystallography and be comfortable with several physical characterization technics mentioned above. The applicant should also be fluent in English and be enthusiast to spend some time in Japan in Pr. Satoshi Horike group at Kyoto University.[4]

To apply: Submit a cover letter, a CV, the marks of your masters and contact information for references by following this link: https://bit.ly/2V9zbxf.
Salary: 1715 € per month (after taxes).
Start and duration of the PhD: from 1st October 2020 to 30th September 2023.
Deadline to apply: 30th June 2020.

[1]. C. Lavenn; L. Okhrimenko; N. Guillou; M. Monge; G. Ledoux; C. Dujardin; R. Chiriac; A. Fateeva; A. Demessence, *J. Mater Chem. C*, **2015**, *3*, 4115.

[2]. (a) C. Lavenn; N. Guillou; M. Monge; D. Podbevšek; G. Ledoux; A. Fateeva; A. Demessence, *Chem. Commun.*, **2016**, *52*, 9063; (b) O. Veselska; L. Okhrimenko; N. Guillou; D. Podbevsek; G. Ledoux; C. Dujardin; M. Monge; D. M. Chevrier; R. Yang; P. Zhang; A. Fateeva; A. Demessence, *J. Mater Chem. C*, **2017**, *5*, 9843; (c) O. Veselska; D. Podbevšek; G. Ledoux; A. Fateeva; A. Demessence, *Chem. Commun.*, **2017**, *53*, 12225; (d) O. Veselska; L. Cai; D. Podbevsek; G. Ledoux; N. Guillou; G. Pilet; A. Fateeva; A. Demessence, *Inorg. Chem.*, **2018**, DOI: 10.1021/acs.inorgchem.7b03090; (e) O. Veselska; L. Cai; D. Podbevšek; G. Ledoux; N. Guillou; G. Pilet; A. Fateeva; A. Demessence, *Inorg. Chem.*, **2018**, *57*, 2736; (f) O. Veselska; A. Demessence, *Coord. Chem. Rev.*, **2018**, *355*, 240; (g) O. Veselska; C. Dessal; S. Melizi; N. Guillou; D. Podbevšek; G. Ledoux; E. Elkaim; A. Fateeva; A. Demessence, *Inorg. Chem.*, **2019**, *58*, 99.

[3]. O. Veselska; N. Guillou; G. Ledoux; C.-C. Huang; K. Dohnalova Newell; E. Elkaim; A. Fateeva; A. Demessence, *Nanomaterials*, **2019**, *9*, 1408.

[4]. (a) S. S. Nagarkar; S. Horike; T. Itakura; B. Le Ouay; A. Demessence; M. Tsujimoto; S. Kitagawa, *Angew. Chem. Ed. Int.*, **2017**, *56*, 4976; (b) T. Itakura; H. Matsui; T. Tada; S. Kitagawa; A. Demessence; S. Horike, *Chem. Sci.*, **2020**, *11*, 1538.