

Postdoctoral fellowship in Materials Chemistry

Luminescent Coordination Polymers for Temperature Resolved Imaging

Work context

A one-year postdoctoral fellowship is available at Lyon University, France, for an exceptional candidate to conduct leading edge research in coordination chemistry, materials science and temperature resolved imaging. This position is part of the TRICoPE (Temperature Resolved Imaging from Coordination Polymers PhotoEmission) research project granted by the labex iMUST (institute for MULTiscale Science & Technology) from Lyon 1 University and it involves three laboratories: *Institute of Researches on Catalysis and Environment of Lyon (IRCELYON)*, Institute for Light and Matter (iLM) and the Physics Lab from ENS Lyon.

Missions

Temperature is one of most often measured parameters in science and technology. In the field of fracture mechanics **temperature is also a determining parameter to understand many different aspects of material failure**. In this project, the objective is to develop a **new optical method to locally measure temperature** in transparent samples, with a good spatial (down to a few microns) and temporal (up to a few kilohertz) resolution, **to measure the transient temperature field around the tip of a crack propagating in a fragile material**. The method is based on **photoemissive components** whose spectral emissions depend on temperature, and a **dual-camera optical set-up** that images simultaneously its field of view in two different wavelength ranges.

The first step of the work is to synthesis **metal-thiolate coordination polymers (CPs)** exhibiting temperature-dependent photo-induced visible emissions, suitable for **ratiometric measurements (Fig. 1)**.^[1] The second step is to embed the CPs in different polymer matrices (Fig. 2), in order to better understand the interplay between crack propagation and heat release in material failure dynamics. This **new resolved thermometric method** will also find applications in situations where conventional infrared (IR) camera imaging is not possible, for example, when samples are opaque to IR, when internal temperature is significantly different from surface temperature, or when fast acquisition is required.

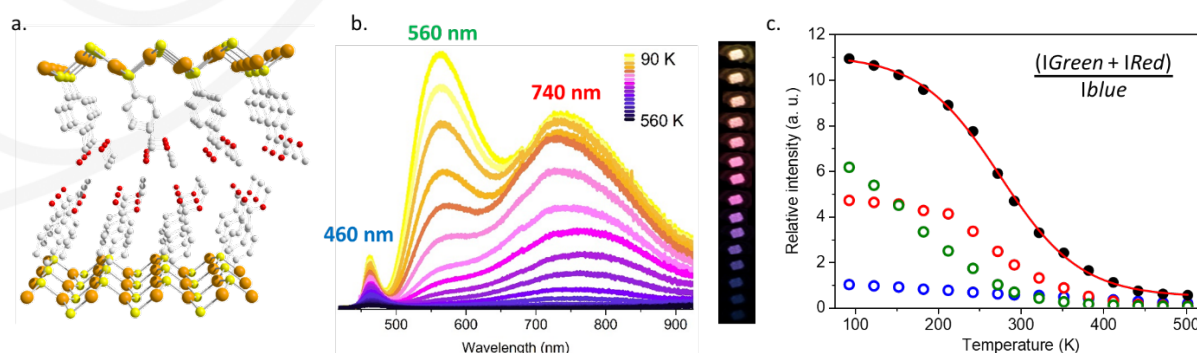


Figure 1. Crystallographic structure of $[Cu(p\text{-SPhCO}_2\text{Me})]_n$ coordination polymer (Orange, Cu; yellow, S; red, O; grey, C. Hydrogen atoms are omitted for clarity), b. the photoemission of $[Cu(p\text{-SPhCO}_2\text{Me})]_n$ in the solid state from 90 to 560 K and with $\lambda_{ex} = 380$ nm and c. the relative emission intensities of the three bands and the plot of $(I_{Green} + I_{Red})/I_{Blue}$, (black circles) with the Boltzmann sigmoidal fit (red curve) used for temperature reading.

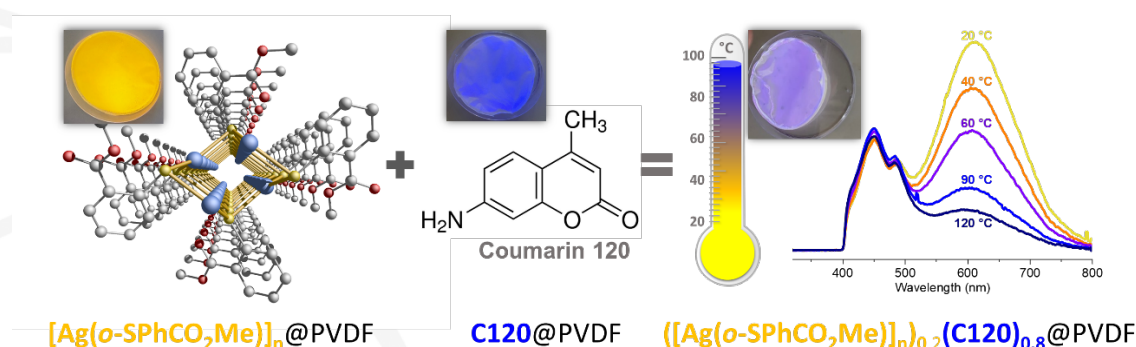


Figure 2. Formation of composite films of PVDF mixing the yellow emissive $[Ag(o-SPhCO_2Me)]_n$ coordination polymer with the blue-emissive coumarin 120 and showing dual emission with temperature sensibility up to 120°C.^[1g]

Activities

- Perform synthesis of CPs made of d^{10} coinage metals and thiolate ligands
- Perform their structural characterizations: PXRD, TGA, DSC, FT-IR, XPS, structure resolution.
- Fabricate films or matrices of the composite materials made of these CPs and organic polymers or silica.
- Perform in-depth spectroscopic measurements with temperature (absorption and luminescence).
- Optimize the dual emission of the materials
- Carry out the *in-situ* experiments of crack propagation and temperature measurements.

Skills

- Strong knowledge in coordination chemistry and materials science and in all the basic characterization techniques.
- Strong knowledge in crystallography and spectroscopy (absorption and photoemission).
- English speaking and writing.
- Bibliographic research, writing articles.

Constraints and risks

Be able to work between three labs, one of chemistry and two of physics, all located in Lyon area.

Advisors: Dr. Aude Demessence and Dr. Adel Mesbah (IRCELYON); Dr. Antoine Bérut and Loic Vanel (ILM); Stéphane Santucci (ENS).

To apply: Submit a cover letter, a CV and contact information for references by following this link: <https://emploi.cnrs.fr/Offres/CDD/UMR5256-AUDEM-003/Default.aspx>.

Salary: from 2889 to 4082 euros per month (before taxes) depending on the experience.

Duration of the fellowship: one year.

Deadline to apply: 31st March 2023.

[1] a) O. Veselska, S. Vaidya, C. Das, N. Guillou, P. Bordet, A. Fateeva, F. Toche, R. Chiriac, G. Ledoux, S. Wuttke, S. Horike and A. Demessence, *Angew. Chem. Int. Ed.* **2022**, *61*, e202117261; b) O. Veselska, N. Guillou, M. Diaz-Lopez, P. Bordet, G. Ledoux, S. Lebègue, A. Mesbah, A. Fateeva and A. Demessence, *ChemPhotoChem* **2022**, *6*, e202200030; c) S. Vaidya, O. Veselska, A. Zhadan, M. Diaz-Lopez, Y. Joly, P. Bordet, N. Guillou, C. Dujardin, G. Ledoux, F. Toche, R. Chiriac, A. Fateeva, S. Horike and A. Demessence, *Chem. Sci.* **2020**, *11*, 6815-6823; d) O. Veselska, N. Guillou, G. Ledoux, C.-C. Huang, K. Dohnalova Newell, E. Elkaim, A. Fateeva and A. Demessence, *Nanomaterials* **2019**, *9*, 1408; e) O. Veselska, D. Podbevšek, G. Ledoux, A. Fateeva and A. Demessence, *Chem. Commun.* **2017**, *53*, 12225-12228; f) O. Veselska, L. Okhrimenko, N. Guillou, D. Podbevšek, G. Ledoux, C. Dujardin, M. Monge, D. M. Chevrier, R. Yang, P. Zhang, A. Fateeva and A. Demessence, *J. Mater Chem. C* **2017**, *5*, 9843-9848; g) A. Abdallah, S. Vaidya, S. Hawila, S.-L. Ornis, G. Nebois, A. Barnet, N. Guillou, A. Fateeva, A. Mesbah, G. Ledoux, A. Bérut, L. Vanel and A. Demessence, *iScience* **2023**, *26*, 106016.