

CMD30 FisMat 2023

Milan, September 4th-8th

Joint Conference of the Italian and European Community of Condensed Matter Physics

Optical properties of MOF-808 before and after Rhodamine B functionalization

L. G. Barbata,^a G. Ficarra,^a A. Sciortino,^a V. Vetri,^a R. Ettliger,^b M. Cannas,^a Russell E. Morris,^b and G. Buscarino^a

^a Dipartimento di Fisica e Chimica - Emilio Segrè, Università di Palermo, Via Archirafi, 36, I-90123 Palermo (Italy)

^b EastChem School of Chemistry, University of St Andrews, North Haugh, St Andrews, UK

e-mail: ludovicogiuseppe.barbata@unipa.it

Metal organic frameworks (MOFs) are well known for their high surface and catalytic properties. Recently, there has been also a growing interest on the luminescence properties of these materials, with potential applications in various fields, such as sensors, LEDs, scintillators. ^[1] One very promising route to obtain luminescent MOFs is to load them with organic luminescent dyes. This approach is both highly versatile and straightforward, as a vast array of dyes with diverse optical properties are available. So, it is possible to tailor the optical properties of a material by properly combining MOFs and dyes.^[2] Nevertheless, for this approach to be viable, it is essential to utilize MOFs that can withstand post-synthetic loading and possess adequately sized cages to effectively accommodate the typically large dye molecules. From this perspective zirconium MOF-808 is a valid candidate for loading organic dyes because it is well known to be chemical and thermally stable and it possesses high surface area (~2000 m²/g) and cages with diameter of 18 Å, that is comparable to the size of many organic dyes.^[3]

Here we present a pioneering study on the luminescent properties of bare **Zr-MOF-808** and MOF-808 loaded with Rhodamine B organic luminescent dye (**MOF-808@RhB**). In this work MOF-808 was synthesized by room temperature approach and later loaded with Rhodamine B by a post-synthetic soaking. The characterizations were performed by XRD, FTIR-ATR, TGA, SEM, and by gas adsorption and porosimetry, while luminescence properties were studied by time resolved photoluminescence (TRPL), both for dry powders and for powders dispersed in water. Our results show that upon UV laser excitation, bare MOF-808 exhibits a wide luminescent band peaked at 425 nm which decays in the nanosecond temporal range. Regarding MOF-808@RhB, we were able to observe both the luminescence bands of the bare MOF-808 and of the embedded Rhodamine B, with the latter red-shifted compared to free Rhodamine in water. Surprisingly, we have found that the two bands observed for MOF-808@RhB share the same decay lifetime which, interestingly, is different from the one pertaining to MOF-808 and Rhodamine B taken alone.

The reported study has us permitted to obtain for the first time an extensive description of the luminescence properties of bare MOF-808 and of MOF-808@RhB interaction. Furthermore, our data indicates that the luminescence properties of Rhodamine B are significantly modified by the interaction between the luminescent molecule and the hosting matrix. These results have strong impact on research focused on luminescent MOFs, shedding new lights on the effects of the host-guest interaction, and making possible prediction for analogue systems.

References

- [1] M. D. Allendorf, et al. *Chem. Soc. Rev.* 2009, 28, 1338-1352
- [2] Y. Cui, et. al. *Chem. Rev.* 2012, 112 (2), 1126-11623
- [3] H. Furukawa, et al. *J. Am. Chem. Soc.* 2014, 136 (11), 4369-4381