

Poster Presentation

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The Road to Functional Lanthanide-Phosphonate Metal-Organic Frameworks

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The endless possible combination of metal centers and organic ligands renders the field of Metal-Organic Frameworks (MOFs) an extremely rich playground for the design of new functional materials. The symbiotic co-existence of organic and inorganic components in these compounds embody the final products with unusual properties, which may, for example, ally photoluminescence with catalysis and even thermal robustness for more advanced technological applications. Our research group has focused on the development of functional MOFs based on rare-earth cations and polyphosphonate organic ligands, many of which designed and prepared in our laboratories. This poster summarizes the synthesis, structural elucidation and photophysical and catalytic properties of the novel one- (1D) and three-dimensional (3D) materials prepared using the tripodal (benzene-1,3,5-triyltris(methylene))triphosphonic acid (H₆bmt) and the bipodal 1,4-phenylenebis(methylene)diphosphonic acid (H₄pmd) organic ligands: [Ln(H₄bmt)(H₅bmt)(H₂O)₂] \cdot 3H₂O (system 1: 1D), [Ln₂(H₃bmt)₂(H₂O)₂] \cdot H₂O (system 2: 3D), and [Ln(Hpmd)(H₂O)] (system 3: 3D) (please note: Ln stands for a rare-earth cation) [1-3]. System 1 is an outstanding heterogeneous catalyst in the methanolysis of styrene oxide at nearly room temperature, even outperforming the well-known nano-sized HKUST-1 MOF material. System 2 exhibits unusual photoluminescent properties: the Tb-containing material has an absolute emission quantum yield of ca. 46%; for the Eu-containing compound this value is easily increased from ca. 15% to 54% by removing, under vacuum, all water molecules in the material, this being only possible due to its typical zeolitic behaviour. System 3 can be prepared in large quantities as either micro- or nano-sized crystals, with the latter exhibiting a remarkable high heterogeneous catalytic activity. Fundação para a Ciência e a Tecnologia (FCT, Portugal; EXPL/CTM-NAN/0013/2013 - FCOMP-01-0124-FEDER-041282), Bruker AXS (Karlsruhe, Germany), the European Union, QREN, FEDER, COMPETE and Laboratório Associado CICECO (PEst-C/CTM/LA0011/2013) are gratefully acknowledged for funding the research and the dissemination of the results. The presenting author also wishes to thank all the collaborators involved in the referenced publications.

[1] S. M. F. Vilela, D. Ananias, J. A. Fernandes et al., *J. Mater. Chem. C*, 2014, DOI: 10.1039/c3tc32114b, [2] S. M. F. Vilela, A. D. G. Firmino, R. F. Mendes et al., *Chem. Commun.*, 2013, 6400-6402., [3] S. M. F. Vilela, D. Ananias, A. C. Gomes et al., *J. Mater. Chem.*, 2013, 18354-18371

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