New generation of robust MOFs for cultural heritage preservation

Al Mohtar, Abeer[a], Pinto, Moisés[a], L., Oleksii Kolmykov[b], Farid Nouar[b], Christian Serre[b]
[a]*Instituto Superior Técnico, Departamento de Engenharia Química, CERENA, Universidade de Lisboa, 1049-001 Lisboa, Portugal*

[b]*Institut des Matériaux Poreux de Paris, UMR CNRS 8004, ENS, ESPCI, PSL University, 75005 Paris, France*

Abstract: Although found in very low concentrations, acetic acid that is one main factor contributing to the degradation of still and movie pictures, paintings and many other types of cultural heritage items. Recently MOFs have shown to have a significantly better performance in capturing highly volatile acetic acid, in the presence of moisture, than other conventional adsorbents in conditions normally found in museum and archives [1]. It has been proven that the ligand functionalization based on lipophilic but polar (e.g., perfluoro) groups enhanced the interactions with acetic acid without increasing the affinity for water [1]. Despite the very promising behaviour of these types of MOFs, some challenges are still to be overcome, like cost-effective synthesis, optimized activation conditions and synthesis in green solvents.

In this work, we show a new generation of MOFs with optimum performance and address the above-mentioned problems, to target an effective application of MOFs in cultural heritage protection. Hydrophobic Zr, Al or Fe carboxylate water stable flexible or rigid MOFs, with different pore sizes, topologies have been synthesised under green conditions using alkyl or fluorinated groups grafted on the linkers or directly on the metal oxoclusters. Basic characterization techniques (PXRD, TGA, FTIR, porosimetry, SEM…) have been performed to analyse the structure and composition of the new compounds.

Kinetic and equilibrium behaviour of acetic acid adsorption experiments on the MOFs have finally been performed to understand the influence of the structure type and group substitution. Acetic acid sorption tests in the presence of air moisture were finally conducted to demonstrate the better performances of the title MOFs under real-life conditions.

[1] K. Dedecker, R.S. Pillai, F. Nouar, J. Pires, N. Steunou, E. Dumas, G. Maurin, C. Serre, and M.L. Pinto. *ACS applied materials & interfaces,* **10**,13886-13894 (2018)