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Mimicking ion channels with nanoMOFs to develop biosensors

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The detection of early stage biomarkers is of crucial interest for diagnostics and therapeutics to prevent disease onset. To this end, numerous single molecule strategies have been proposed and in terms of label-free routes, nanopore sensing has emerged as one of the most promising methods.[1] However, being able to finely control molecular transport in terms of transport rate, resolution and signal-to-noise ratio is essential to take full advantage of this technology.[2] Here we propose a novel solution to these challenges. MOFs are promising for biomedical applications due to their ability to separate ions.[3] Inspired by biological channels that allow the transport of ions or molecules between intra- and extra-cellular media, we will address those questions by using nanoMOFs on a solid support.

This presentation will give an overview about metal-organic frameworks (MOFs) as a potential candidate for nanopore technology applications.[4] Their high surface/volume ratio and the extraordinary properties arising from the nanoscale, and porosity (high loading capacities), made them excellent candidates for biological and biomedical field. I will also explain the drawbacks of MOF, in biological fluids, as they tend to aggregate and degrade in phosphate solution because of the progressive replacement of the carboxylic linkers by phosphate. High content of biomacromolecules–such as lipids, sugars, nucleic acids and, especially, proteins–also affects nanoMOF stability and their viability for many applications. I will focus on the strategies we are developing to combine the nanopore support and the nanoMOFs to achieve a stable sensor. MOFs have great potential as nanopore biosensors, we hope to demonstrate their versatile advantages over other candidates of nanopore-sensory nanomaterials for ionic selectivity and single molecule detection.

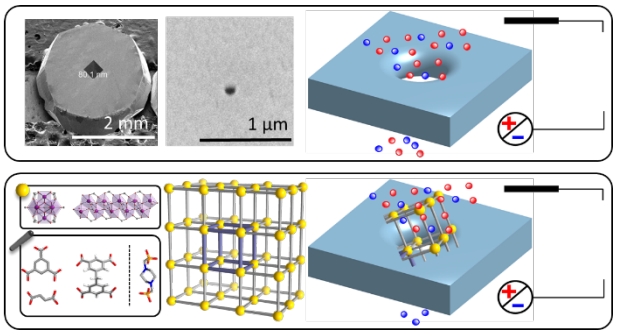

Figure 1 : SEM picture of SiN nanopore, b. Construction and topology of MOFs crystalline 3D structure, the yellow sphere represents the inorganic building unit (Al^{3+}; Zr^{4+}…) they can be single metal ions, oxo-clusters, chains. The grey spacers are the organic building units, multitopic organic ligands and linkers

1. Dekker, *Nat Nano* **2007,** *2* (4), 209.
2. Lepoitevin, et al., *Advances in Colloid and Interface Science* **2017,** *250*, 195.
3. Lu, et al., *Nature Materials* **2020**.
4. (a) Simon-Yarza, et al., *Angewandte Chemie International Edition* **2017,** *56* (49), 15565; (b) Horcajada, et al., *Chemical Communications* **2007,** (27), 2820.