

# Ionic Liquid Threaded Metal-Organic Frameworks for Anion-Exchange Application

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Anion-exchange materials (AEMs) are important in many electrochemical energy systems such as fuel cells, electrolyzers, electrodialysis cells and redox flow batteries. The key properties desired for high performance in such devices, which include high ion exchange capacity, ion selectivity, fast ion exchange kinetics and excellent chemical stability, are lacking in the commercially available AEMs. Therefore, in order to meet the growing needs for ion-selective polymers, we have developed new anion exchangers through the incorporation of polyelectrolytes into the cavities of the highly porous metal-organic frameworks (MOFs).

We present the direct synthesis of a poly (ionic liquid) within the cavities of a zirconium terephthalate MOF, also known as UiO-66. [1] The synthesis protocol is an *in situ* polymerization of an ionic liquid monomer, 3-methyl-1-vinylimidazolium iodide (3MVIm-I) within the pores of UiO-66 under mild conditions. The product designated as P3MVim-I~UiO-66 has a high ion exchange capacity of 6.05 meq g<sup>-1</sup> and a Brunauer–Emmett–Teller surface area of 889 m<sup>2</sup> g<sup>-1</sup>. When suspended in the aqueous solution of mixed ionic dyes, P3MVim-I~UiO-66 demonstrates better ion selectivity than the pristine UiO-66 and the commercially available resin, Amberlyst A26. More than 95 % of cationic Rhodamine B (Rh-B) are rejected by P3MVim-I~UiO-66 while over 90 % of Acid blue 9 (AB9) are exchanged under the same condition. The commercial resin rejects ~ 65 % of Rh-B while the pristine UiO-66 shows no ion selectivity. The highly organized porous structure of the polyelectrolytes-threaded MOFs can provide enhanced ion exchange kinetics as shown in another study [2]. The alkaline stable anion exchange composite, PVBTAAH~ZIF-8, displays superior ion exchange kinetics to Amberlyst A26.

The polymer-MOF composites exhibit outstanding ion exchange performance and are promising for future applications in electrochemical systems.

## References:

[1] J.F. Olorunyomi, K.-Y. Chan, L. Gao, A. Voskanyan, C.-Y.V. Li, *Microporous Mesoporous Mater.* 259 (2018) 255-263.

[2] L. Gao, C.Y. Li, K.-Y. Chan, Z.N. Chen, *J. Am. Chem. Soc.*, 136 (2014) 7209-7912.

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