The design of highly stable MOF/polymer composites for the extraction of metal ions from complex aqueous mixtures

Daniel Sun, Shuliang Yang, Bardiya Valizadeh, Li Peng, Vikram Karve, Emad Oveisi, Wendy L. Queen

Institute of Chemical Sciences and Engineering, LFIM, École Polytechnique Fédérale de Lausanne (EPFL) Valais Wallis, Rue de l'Industrie 17,1950 Sion, Switzerland; wendy.queen@epfl.ch

Drinking water contaminated with heavy metals is a serious problem worldwide; existing purification methods cannot often address this issue quickly and economically. This shortfall has sparked our interest in the exploration of metal−organic frameworks (MOFs) for water purification. The attraction to deploy MOFs in this application is due to their easy chemical tunability allowing their internal surface to be decorated with high densities of metal scavenging functionality.[1-3] Recently, we have used a cheap, environmentally friendly MOF template, Fe-BTC, to introduce extrinsic porosity to a series of polymers that contain high densities of Lewis base functionalities, such as amines, catechols, and thiols.[1,3] This functionality not only promotes the rapid extraction of selected metals, such as lead, mercury, and gold, from a variety of complex solutions, but also provides a pathway to adhere the polymer onto the internal MOF surface.[1,3] The latter inhibits the dispersion of the hydrophilic polymer into water and thus promotes facile separation post-water treatment. In this presentation, examples of several resulting composites will be shown, demonstrating their application in the removal of metal ions from highly complex water mixtures such as sea water, river water, industrial waste water, and liquids used to leach metals from electronic waste and the incinerated ash of sewage sludge.[1-3] Further, newly developed polymerization strategies, used to make MOF/polymer composites, will be discussed. Such methods can (*i*) improve the chemical and mechanical stability of MOFs and MOF/nanoparticle composites [4-6] and (*ii*) be used to design structured MOF beads;[2] the latter is a requirement for the implementation of MOF materials in industrial-based separations that are carried out under continuous flow.

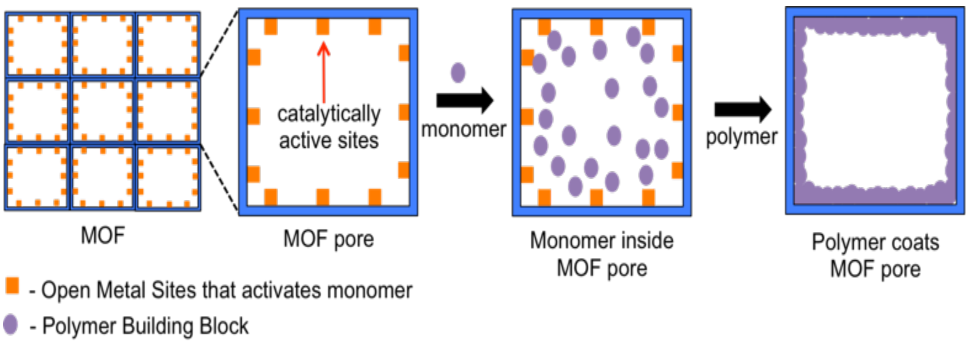

Fig. 1. Metal-organic frameworks (MOFs) are used as templates for in-situ polymerization.

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