How to Enhance ZIF-8 Growth on Porous Polymers?

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ZIF-8 became the most studied MOF for membrane's applications mainly because of its easy synthesis, good chemical and thermal stabilities, recent commercial availability and pore size of 3.4 Å. Thin dense ZIF-8 layers have been successfully synthesized on inorganic supports and offered superior selective properties. However polymeric supports have advantages, because they are much cheaper, they are light, they can be easily produced on large scale and module fabrication is easier.

The aim of our work is to develop simple methods for growing ZIF-8 thin layers on polymer supports. The challenge is to obtain well-intergrown thin compact and defect-free ZIFs layer on a flexible porous polymer. We present new methods for preparation ZIF-8 membranes on polymers. We introduced presence of zinc oxide nanoparticles in the support as a secondary metal source for ZIF-8 growth. Initially the ZnO particles were incorporated in the polymer matrix and later on the surface of the polymer by magnetron sputtering (1,2). In both cases the ZnO helped to create more nucleation opportunities for ZIF-8 and improved the ZIF-8 growth comparing to synthesis without using ZnO. We were able to obtain very thin (900 nm) ZIF-8 layer with significant separation performance. To the best of our knowledge, this is the thinnest ZIF-8 layer synthesized on polymeric substrate by secondary growth method so far.

Another promising method to facilitate the growth of MOF's on polymeric supports is the chemical functionalization of the membrane surface and pore walls with functional groups, which can complex metal ions and which can covalently bond the MOF crystals. We functionalized the surface of porous polymeric membranes with tetrazole and imidazole groups, which took part in the reaction to form ZIF-8 nanocrystals. Very thin defect-free ZIF layers could be obtained by the standard secondary growth method and by a counter diffusion method. Obtained membranes were tested for permeation of hydrogen and hydrocarbons. Promising selectivities higher 50 could be obtained. The ZIF-8 layers were analyzed by scanning electron microscope and X-ray diffraction.

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