

PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Formulation Of Chitosan-MOF-808 Core-shell Fibers For Organophosphate Hydrolysis Under Non-buffered Conditions

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Metal-organic frameworks (MOFs) that contain $Zr_6O_4(OH)_4$ secondary building units (SBUs) have been shown to facilitate organophosphate hydrolysis, however, they often necessitate amine buffers to facilitate high activity and turnover. The buffer facilitates removal of carboxylic modulators which generate “missing-linker” sites that provide active site binding for organophosphate hydrolysis. While non-volatile buffers can be integrated into MOF composites with amine polymers, all solid-state MOFs formulations suffer reduced organophosphate hydrolysis due to the reduction of MOF accessibility and hydrophilicity within composites. Herein, we utilized a hydrophilic biopolymer in conjunction with MOF-808 to fabricate highly active composites for the hydrolysis of dimethyl-p-nitrophenylphosphate (DMNP) under non-buffered conditions. In addition, we used an acrylic 3D printed dual nozzle in the fabrication of highly reactive core-shell wet spun fibers. This fabrication process is amenable to different core polymers and facilitates modular fiber strength and elastic properties. We demonstrate that polyelectrolyte complexation facilitates enhanced MOF sheath coverage of the core fibers and consequently increased DMNP hydrolysis. To enhance MOF sheath retention upon physical manipulation of elastic fibers, we chemically adhered the MOF/biopolymer sheath to a functionalized elastic polymer through simple dip-coating and core-shell procedures. We believe that our newly fabricated active fibers offer advancements for the practical and recyclable utilization of MOF composites for organophosphate protection.

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