MESOPOROUS UiO-66-NH_2 THIN FILM GROWTH ON TiO_2 COATED FABRICS USING ATOMIC LAYER DEPOSITION (ALD) FOR ENHANCED ORGANOPHOSPHATE DEGRADATION

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Nowadays, most of the UiO-66-NH_2 research focuses on the capabilities of the microporous UiO-66-NH_2-fabric composites for organophosphate degradation via hydrolysis. Unfortunately, microporous UiO-66-NH_2 suffers from diffusion limitation of the bulky organophosphates accessing the active sites. As a novel solution, we are introducing the aqueous phase synthesized mesoporous UiO-66-NH_2 thin film on fabric coated with ≈20 nm TiO_2 using ALD. The mesoporous version of UiO-66-NH_2 overcomes the mass transfer limitation issues while the TiO_2 layer works as nucleation centers to form a dense, robust, and homogeneous MOF thin films. The mesoporosity of the solvothermally synthesized UiO-66-NH_2-fabric composites is mainly due to the utilization of an amphoteric surfactant, CAPB, as a template to construct these mesochannels.[1] Fig.(1,a) shows the benign MOF synthesis process avoiding the common toxic solvents and highly acidic medium at elevated temperatures. Importantly, Fig.(1,b) shows the pore size distribution of mesoporous UiO-66-NH_2 has both characteristic pore width peaks corresponding to the microporous range and a new peak at ≈28 Å corresponding to the mesoporous range. The benign synthesis approach allows mesoporous UiO-66-NH_2 growth on a range of fabrics. Fig.(1,c) shows a MOF thin film on PP coated with TiO_2 using atomic layer deposition that achieves BET SA up to ≈360 m^2/g_{comp}. Fig.(1,d) shows that these mesoporous UiO-66-NH_2 composite enhanced the paraoxon methyl (DMNP) degradation with a half-life time of less than a minute compared to a half-life time of 2.5 minutes for microporous UiO-66-NH_2. Similar trends were found for live nerve agent degradation. To conclude, the benign synthesis process of the mesoporous UiO-66-NH_2 thin film improves the growth of this MOF on a large range of fabrics and enhances the organophosphates degradation, respectively. These thin film MOF-fabric composites have great potential in filtration, protection, and catalysis applications.

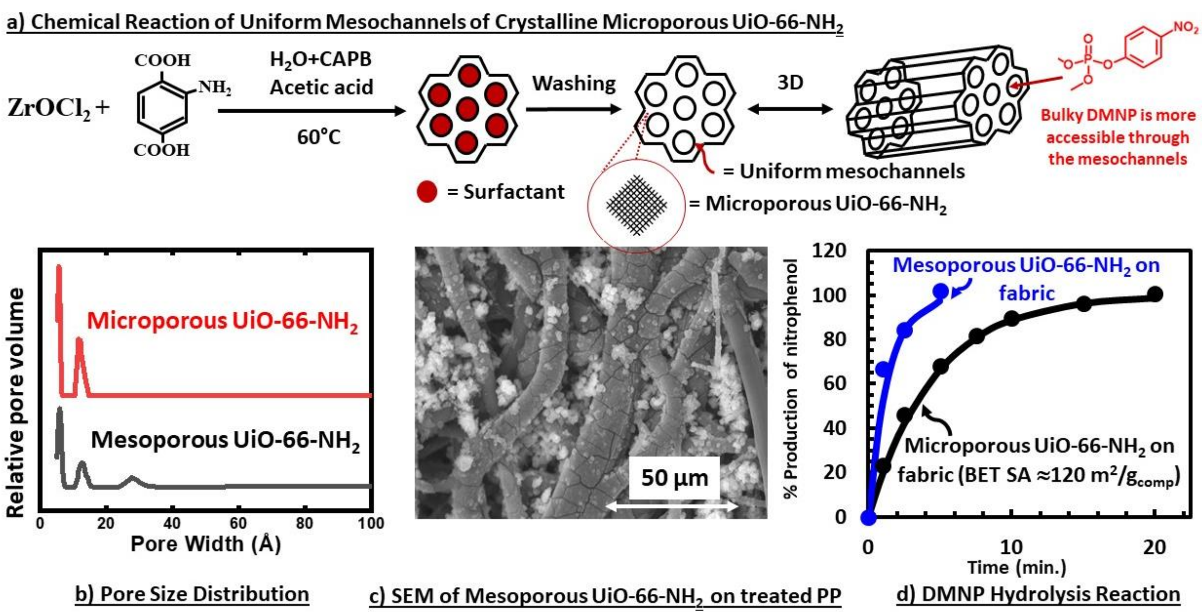

Figure (1): a) Chemical Reaction of Uniform Mesochannels of Crystalline Microporous UiO-66-NH_2, b) Pore Size Distribution of Mesoporous vs Microporous UiO-66-NH_2, c) SEM of Mesoporous UiO-66-NH_2 on Treated PP, d) DMNP Hydrolysis Results.

[1] K. Li, S. Lin, Y. Li, Q. Zhuaang, J. Gu, Angewandte Chemie - Int. Ed. 57 (2018) 3439–3443.