Poster

Novel BioMOF@PAN Mixed Matrix Membranes as Highly Per-formant Adsorbing Materials for Multiple Heavy Metal Ions Removal

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The contamination of aquatic ecosystems by anthropogenic activities presents a pressing global concern, necessitating effective water purification strategies to mitigate environmental and health risks. Traditional urban wastewater treatment methods often fail to adequately remove micropollutants, emphasizing the need for advanced water treatment solutions [1-2]. In particular, heavy metals such as cadmium, mercury, nickel, and lead, classified as priority hazardous substances (PHSs), under the criteria for Substances of Very High Concern (SVHCs) under REACH, necessitate specialized removal techniques due to their persistence and toxicity. Membrane-based separation offers promise in addressing water scarcity and pollution challenges, but faces limitations in structure and properties, prompting the exploration of novel materials like adsorptive membranes [3-4]. Metal-organic frameworks (MOFs) have emerged as promising fillers in mixed-matrix membranes (MMMs) due to their regular pore structures and functional surfaces [5]. Recently developed MOFs derived from natural amino acids show potential for water remediation, exhibiting efficient adsorption of organic molecules [6] and heavy metal cations [7]. Integrating these MOFs into polymeric films enhances selectivity and pollutant removal efficiency.

In this work, we report two novel MMM-MOFs incorporating water-stable isoreticular zinc (II)-based BioMOFs with formulas $\{Ca^{II}Zn^{II}_6[(S,S)\text{-Mecysmox}]_3(OH)_2(H_2O)\} \cdot 12H_2O$ (1) and the novel $\{Ca^{II}Zn^{II}_6[(S,S)\text{-Methox}]_3(OH)_2(H_2O)\} \cdot 16H_2O\}$(2) Fig.1 as adsorbing fillers and polyacrylonitrile (PAN) as the matrix. Their thioether groups, deriving from the S-methyl-L-cysteine (1) and (S)-methionine (2) amino acid residues, can recognize and capture Pb^{2+} and Hg^{2+} ions. The oxygen atoms of the oxamate moieties, preferentially interact with Cd^{2+} ions. Furthermore, the flexibility of the pore environments, allows these sites to work synergically for the simultaneous capture of different metal ions. Finally, the stability of the membranes for a potential regeneration process, a key factor for the effective feasibility of the process in real-life applications, was also evaluated and confirmed less than 1% capacity loss in each cycle.

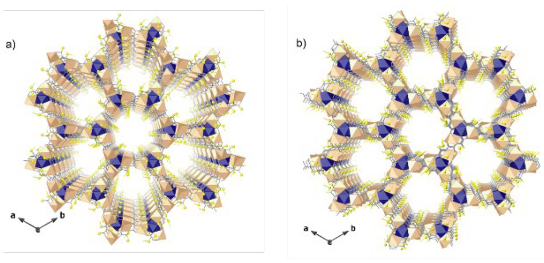

Figure 1. View of the porous crystal structures of 1(a) and 2 (b) emphasizing their functional channels decorated with $-CH_2SCH_3$ and $-CH_2CH_2SCH_3$ groups for 1 and 2, respectively.

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