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Internal pore decoration with polydopamine nanoparticle on polymeric ultrafiltration membrane for enhanced heavy metal removal

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Abstract: Novel ultrafiltration-adsorption membranes (UFAMs) were designed via decorating the walls of membrane internal pores with polydopamine (PDA) nanoparticles for heavy metals removal. Specially, self-polymerized dopamine solution was penetrated through the polyethersulfone (PES) UF membrane from reverse direction (i.e., from bottom to top) by circulatory filtration, leading to the formation of a PDA nanoparticle coating around the walls of finger-like pores (labeled as PES/PDA-R). The conventional PDA-decorated membrane (labeled as PES/PDA-F) prepared with forward filtration was used for comparison. The results indicated that the introduction of PDA nanoparticles on the walls of internal pores endowed the PES/PDA-R membrane with enhanced UF performance and remarkable adsorption capacity for heavy metals. PES/PDA-R membrane exhibited ascendant bovine serum albumin (BSA) rejection (92.9 %) and maintainable pure water flux (166 L/m^{2}h). The static adsorption capacities for Pb^{2+}, Cd^{2+} and Cu^{2+} on PES/PDA-R membranes were 20.23 mg Pb/g, 17.01 mg Cd/g and 10.42 mg Cu/g, respectively, which are 1.69, 2.25 and 1.91 times higher than that of the PES/PDA-F membranes. Importantly, dynamic filtration experiments revealed 4.13 times adsorption capacity for Pb^{2+} was achieved on PES/PDA-R membrane over PES/PDA-F membrane. The significant enhancement of dynamic adsorption capacity on PES/PDA-R membrane is derived from the three dimensional distribution of

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