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Poly sodium acrylate (PSA) composite cryogels for simultaneous oil and dye removal

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Oily substances and other organic pollutants are currently a persistent and common problem that has induced severe water pollution. Porous materials with special wettability have been proven efficient oil-removal systems for separating oil-water mixtures by filtration.[1,2] However, additional water-soluble pollutants may pass through the filters together with the water, limiting the success of the remediation process. Therefore, to successfully deal with multicomponent oily wastewater, the fabrication of advanced functional filters that can perform integrated removal processes is needed.
Hydrogels-based materials are a promising approach to address this issue. Because of their hydrophilicity and underwater superoleophobicity, they can effectively separation of oil-water mixtures. Also, the numerous active functional groups within the hydrogel networks endow them with the ability to adsorb organic molecules and to anchor nanomaterials. As such, various hydrogel-based materials have been developed for sequential oil and dye separation. However, the efficiency of such systems is limited as the oils and dyes are removed in separate steps, complicating the water treatment process. Additionally, cleaning the filters with caustic and corrosive solutions after dye adsorption might affect their durability and pose environmental hazards. For this reason, the aim of this work is focused on developing free-standing hydrogels that can perform simultaneous multicomponent oil-water separation while possessing self-cleaning ability.
The poly sodium acrylate cryogels were formed by conducting a polymerization reaction in a semi-frozen system, in which the ice crystals serve as pore templates. Then, PSA cryogels were loaded with Zn^{2+} for the in-situ formation of ZnO particles. The fabricated cryogels were used as filters for the gravity-driven filtration of oil-water, dye-water, and oil-dye-water mixtures. In all cases, fast flow rates (> 9000 L m^{-2} h^{-1}) and high separation efficiencies (>98%) are observed. The composite cryogels have self-cleaning photocatalytic properties making possible the degradation of the sorbed dye and their potential re-utilization. In conclusion, the PSA-ZnO composites display multifunctional properties for the simultaneous removal of oil and dye from water, as well as photocatalytic self-cleaning properties, representing a simple approach to perform an integrated water treatment process.

References:

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[2] *Z, Soheil, et al. Progress in Polymer Science, 98 (2019) 101166.*

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