

MXene Confined Microcapsules for Uremic Toxins elimination

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Abstract

Adsorbents with high adsorption efficiency and excellent biosafety for biomedical applications are highly required. MXene is a promising candidate owning these advantages, yet pristine MXene faces dilemmas including insufficient utility of surface site as well as limited processibility. Here, we develop MXene-encapsulated porous microcapsules via microfluidics. The microcapsules have a biomass hydrogel shell that provides a robust support for MXene in the core, by which the microcapsules are endowed with high MXene dosage and remarkable biosafety. Additionally, the MXene nanoflakes assemble into a three-dimension (3D) network via metal ion-induced gelation, thereby avoiding restacking and significantly improving surface utilization. Moreover, a freeze-pretreatment of the microcapsules during preparation results in the formation of a macroporous structure in the shell, which can facilitate the diffusion of the target molecules. These features, combined with additional magneto-responsiveness rendered by the incorporation of magnetic nanoparticles, contribute to prominent performances of the microcapsules in cleaning uremia toxins including creatinine, urea, and uric acid. Thus, it is anticipated that the MXene-encapsulated microcapsules will be promising adsorbents in dialysis-related applications, and the combination of microfluidic encapsulation with metal ion gelation will provide a novel approach for construction of hybrid MXene materials with desired functions.

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