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Superabsorbent Polymer with Fast Water Uptake and Discharge for Liquid Absorption and Recycling

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Abstract : Superabsorbent polymers (SAPs) hold significant applications in agriculture or construction applications due to their remarkable absorbency. With the increased demand of SAPs market, the development of SPA has become more mature and stable. Although SAPs can absorb water up to hundreds of times their own weight, they undergo a time-consuming process to discharge or recycle the absorbed water. For example, the absorbed water is typically released through evaporation or mechanical compression. However, evaporation is highly dependent on the surrounding environment, and compression can damage the polymer microstructure. Therefore, microstructure modification to enhance both fast absorption and efficient discharge is highly desired. In this work, a SAP hydrogel was synthesized through freeze-casting and cryo-polymerization of acrylamide. The hydrogel precursor was placed onto a metal finger immersed in liquid nitrogen, allowing ice pillars to form upward from the bottom via unidirectional freeze casting. The frozen sample then underwent cryo-polymerization to form a three-dimensional, cross-linked structure. After removing the ice pillars, a well-aligned porous structure remained. The fabricated polyacrylamide with an aligned porous structure enables rapid water uptake within seconds. Moreover, the absorbent water can be easily squeezed out without damaging the structure. The compressed sample can also reswell, allowing for cyclic hydration and dehydration processes. This soft superabsorbent polymer with fast and easy water uptake and discharge properties holds promise for use in hygiene, agriculture and construction fields.

Keywords : absorbency, cryo-polymerization, freeze-casing, superabsorbent polymers
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