Antifreeze, Conductive and Flexible Ternary PVA/PVP/SA Hydrogels

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Polyvinylpyrrolidone (PVP) has excellent water solubility, biocompatibility and surface activity, which has been widely used in medicine, biomedical engineering, cosmetics and food. PVP and its monomers are water-soluble, while cross-linked PVP or its copolymers are insoluble in water, but can absorb water and form hydrogels. PVP hydrogels are widely used in medical and biomedical engineering because of their excellent biocompatibility. The current work combined PVP with polyvinyl alcohol/sodium alginate (PVA/SA) to from a ternary antifreeze conductive hydrogel by repeated freezing-thawing method and ion cross-linking method. During cross-linking process, the pyrrolidone group was indroced to improve the conductivity. The PVA crystallization network and SA ion cross-linking network are interpenetrated, which increases the mechanical properties of the hydrogel network and makes the hydrogel have both frost resistance and conductivity. Thus, the PVA/PVP/SA hydrogels showed good mechanical and electrical properties, with further modification of ethylene glycol (EG) as a bridging agent, the hydrogels exhibited certain low temperature resistance while maintained good mechanical and electrical properties at low temperature. A supercapacitor was constructed by utilizing the ternary PVA/PVP/SA hydrogel as electrolyte, which revealed a specific capacitance of 7 mF cm^{-2} at the current density of 0.5 mA cm^{-2}, indicating a good prospect in the field of flexible energy storage.

Keywords: Antifreeze hydrogel; Conductive hydrogel; Supercapacitor