

无机盐构筑的 MXene 功能化木基柔性水凝胶及其传感性能研究*

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摘要: 通过“自上而下”方法制备木材水凝胶引起了研究者的广泛关注。在本研究中, 二维和导电的 MXenes 被用作填料和功能剂, 以赋予具有多功能的木材水凝胶。具体来说, 使用无机 ZnCl_2 溶液体系将木材基质直接转化为木材水凝胶。 ZnCl_2 具有促进 MXenes 脱落和分散, 同时诱导纤维素纤维重排的双重作用。纤维素和 MXenes 之间可以构建广泛的氢键网络, Zn^{2+} 离子和羟基之间的离子配位为复合水凝胶提供了二级交联网络。在 MXenes 和 Zn^{2+} 离子的作用下, 制备的木材水凝胶具有良好的各向异性、优异的机械性能、高导电性和极端的耐温性。此外, 木材水凝胶在人体运动检测、温度传感和光热转换等健康监测应用中显示出巨大的潜力。该研究为开发具有高导电性和宽温度响应范围的木材水凝胶传感器系统提供了一种简单的策略。

关键词: 木材水凝胶; 无机盐; MXene; 传感

MXene-functionalized wood-based flexible hydrogels constructed with inorganic salts and their sensing properties

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Abstract: The preparation of wood hydrogels through a "top-down" approach has attracted much attention from researchers. In this study, two-dimensional and conductive MXenes were used as fillers and functional agents to impart multifunctionality to wood hydrogels. Specifically, the wood matrix was directly converted into wood hydrogels using an inorganic ZnCl_2 solution system. ZnCl_2 had the dual effect of promoting MXenes exfoliation and dispersion while inducing cellulose fibre rearrangement. An extensive hydrogen bonding network could be constructed between cellulose and MXenes, and the ionic coordination between Zn^{2+} ions and hydroxyl groups provided a secondary crosslinking network for the composite hydrogel. In the presence of MXenes and Zn^{2+} ions, the prepared wood hydrogels exhibited good anisotropy, excellent mechanical properties, high electrical conductivity and extreme temperature resistance. In addition, wood hydrogels show great potential for health monitoring applications such as human motion detection, temperature sensing and photothermal conversion. This study provides a simple strategy for the development of wood hydrogel sensor systems with high electrical conductivity and wide temperature response range.

Key words: wood hydrogel; inorganic salt; MXene; sensing.