

PROCEEDINGS

Engineering Multifunctional Hydrogel Interfaces via Dynamic Molecular Interactions for Sustainable Bioelectronics

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ABSTRACT

Smart interfaces bridging soft matter with biological or environmental surfaces are pivotal for next-generation flexible electronics. [1] Here, we present multifunctional hydrogel systems—incorporating lignin [2], MXenes [3], and cellulose nanofibers [4]—engineered via dynamic molecular interactions such as hydrogen bonding, dipole-dipole, and Schiff base linkages. These "smart" interfaces address critical challenges in interfacial mechanics and stability. Key achievements include: (1) repeatable adhesion to diverse substrates, including human skin, plant leaves, and underwater environments; and (2) sustainability through full recyclability and degradability. Furthermore, the integration of AI-assisted monitoring⁴ and multimodal sensing expands their utility from motion and electroencephalogram recording [5] to precision agriculture. This research provides fundamental insights into the physics of soft-hard matter interfaces and offers advanced solutions for human-machine interaction and sustainable environmental sensing.

KEYWORDS

Smart interfaces; conductive hydrogels; self-adhesion; wearable sensors; sustainability

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Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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