PÔSTER - RESUMO - MATERIAIS E BIOMATERIAIS

DEVELOPMENT AND CHARACTERIZATION OF SELF-HEALING SEMICONDUCTOR HYDROGELS FOR ENERGY STORAGE APPLICATIONS

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The demand for flexible and sustainable energy storage devices has driven the development of advanced materials capable of maintaining structural integrity under mechanical stress. Conductive hydrogels emerge as promising candidates due to their unique combination of hydrophilic properties, mechanical flexibility, and electrical conductivity [1],[2]. However, mechanical failure remains a significant challenge for the long-term stability of these devices [3]. This work focuses on the development of a self-healing semiconductor hydrogel system specifically designed for potential applications in batteries and supercapacitors. The study investigates a specific formulation centered on the polymerization of acrylic acid within an aqueous medium of PEDOT:PSS. The synthesis utilizes ammonium persulfate (APS) as the radical initiator. The self-healing mechanism is strategically based on ionic coordination, facilitated by the incorporation of Iron(III) nitrate, which acts as a dynamic crosslinker. Initial tests focused on evaluating the efficiency of different crosslinking strategies, including hydrogen bonding and borate-ester linkages, to identify the most robust mechanism for autonomous repair. Preliminary results indicate that the ionic

coordination route provided the most consistent self-healing performance among the tested strategies. For pristine materials (without glycerin as an additive), total autonomous healing was observed within one hour at room temperature. While glycerin is often used to enhance stability, its presence significantly increased the self-healing time and reduced charge mobility. Electrochemical Impedance Spectroscopy (EIS) confirmed a decrease in ionic conductivity in the presence of glycerin, supporting the hypothesis that the healing delay is intrinsically linked to reduced ionic mobility within the polymer matrix. These findings highlight the critical trade-off between environmental stability and the kinetics of the self-healing process. The initial phase of this research successfully demonstrated the feasibility of producing conductive hydrogels with rapid self-healing capabilities through Fe(III) ionic coordination. The characterization of the physicochemical mechanisms provides a fundamental baseline for the subsequent optimization of the material.

Acknowledgments

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References

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