ELECTROACTIVE FLUORINATED POLYMERS FOR ENERGY TRANSITION: FROM MOLECULAR DESIGN TO DEVICE INTEGRATION

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Résumé :

Thanks to their broad electroactive properties (piezoelectricity, pyroelectricity, electrostriction, high dielectric permittivity …), ferroelectric and relaxor ferroelectric polymers are attractive candidates for advanced functional materials in energy-related applications. Through precise control of molecular architecture and phase morphology, these properties can be tuned to meet specific performance requirements.
This contribution presents recent developments in the design, synthesis, and processing of electroactive fluorinated polymers, with a focus on two application domains directly relevant to the energy transition.
We first investigate the integration of electroactive polymers into sensor architectures for structural health monitoring in renewable energy systems. Their sensitivity to mechanical and acoustic perturbations enables embedded diagnostics and early failure detection, contributing to system reliability and operational safety.
We then describe how electrocaloric polymer materials, are a promising solution to develop efficient, compact solid-state cooling equipment and offer a promising alternative to vapor-compression technologies, with potential for integration into electronics, buildings, and transport.
The presented work spans from polymer chemistry to device-level integration, highlighting the versatility of electroactive polymers as enabling materials for next-generation energy technologies.