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## Natural resources as core components of sustainable energy technologies

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Nature serves as a powerful inspiration for the development of renewable, multifunctional materials capable of addressing today's urgent environmental and energy-related challenges. Among the broad spectrum of natural, biodegradable, and abundant resources, proteins, polysaccharides, and other bio-based compounds stand out due to their inherent biocompatibility, structural diversity, and eco-friendliness. By harnessing these natural building blocks, it is possible to design high-performance materials with applications in advanced technologies such as energy storage, smart windows, and solar harvesting.

This talk explores recent progress in the development of bio-inspired materials, with a particular focus on the integration of natural polymers and carbon-based nanomaterials into functional devices. Recent advancements have introduced promising applications within the energy sector, highlighted by our pioneering contribution with the inaugural integration of silk fibroin as a solid polymer electrolyte in electrochromic devices and batteries [1, 2]. The use of genetically engineered recombinant protein as matrix for the development of solid polymer electrolytes will be discussed. Sun-actuated thermotropic devices incorporating active SF-based films doped with innovative ionic liquids composed of natural-derived carbon dots and ionic liquids will be also presented [3].

Collectively, these advances illustrate the vast potential of natural materials, including genetically engineered recombinant protein polymers, as functional components to develop next-generation, environmentally conscious technologies.

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