Epoxidized Natural Rubber-Graphene -Based Sensors and Energy Harvesters

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Rubber nanocomposites, which combine elastomers with nanomaterials such as graphene, carbon nanotubes, and nanoparticles, are emerging as transformative materials for this paradigm. These composites offer unique properties, including flexibility, lightweight design, mechanical robustness, and enhanced electrical conductivity, making them pivotal for a range of applications.

One prominent use of rubber nanocomposites is in sensors, where the electrical conductivity of the conductive fillers is leveraged to develop resistive sensors that exhibit changes in resistance upon application of external stimuli. In this talk, specific examples of multifunctional sensors based on epoxidized natural rubber (ENR) and graphene will be discussed. In the study window, the ENR-graphene (ENRG) based sensor demonstrated gauge factors of −506 and 407 in bending strain regimes of 0–0.04% and 0.04%–0.09%, respectively, while the temperature sensitivity was −0.96%/°C. [1] The work was extended to the domain of triboelectric nanogenerators (TENGs). A vitrimeric composition was made using ENRG along with a textile, with targeted application as textile TENGs. The record high output performance with a power density of 4.69 W m^{-2} accomplished using a single fabric layer with a thickness of 0.56 mm supports the amalgamation of dielectrically optimized elastomeric coatings with textiles for next-generation self-powered wearables. [2-5] Also, the strategic utilization of dynamic covalent chemistry imparted self-healing properties to the coating.

Accordingly, this talk highlights the potential of rubber and its nanocomposites as a cornerstone for achieving sensor and TENG development goals, offering solutions for automation and greener energy-harvesting technologies.

References

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