A Multifunctional Graphene-Infused Double-Network Hydrogel Composite for Wearable Strain Sensors

Amaal Romih, Yarjan Abdul Samad, Jang Kyo Kim, Andreas Schiffer
Khalifa University of Science and Technology, Al Saada St. Muroor Road, Abu Dhabi, UAE
100059704@ku.ac.ae

Abstract

Driven by the increasing need for implantable and wearable electronics, structurally engineered sensors with enhanced performance including robust sensing capabilities, flexibility, stretchability, biocompatibility, self-adhesiveness and self-healing properties have become essential. This work is focused on developing a multifunctional nanocomposite hydrogel strain sensor, with a structure incorporating graphene ink into chitosan/polyethylene glycol (Cs./PEG) double-network hydrogel coupled with ethylene glycol (EG) to fulfill the above-mentioned requirements. Leveraging the balanced mechanical properties of the two polymers inside double-network hydrogel and the outstanding electrical conductivity of graphene, this strain sensor can detect strains over a wide range, reaching up to 500% facilitating tracking of diverse body motions with a gauge factor of >10. The device exhibits a tensile strength of above 2 MPa for the 0.15 wt.% graphene sample and maintains stability over 100 stretching cycles at 50% strain. Most importantly, the chitosan polymer enables self-adhesion properties owing to its terminal hydroxyl and amino groups which enables hydrogen bonding with different surfaces, including plastic, rubber, glass, metal and human tissues. These findings show a promising capability of the hydrogel nanocomposite as a high-performance candidate for wearable strain sensors and electronics next generation.

Figures

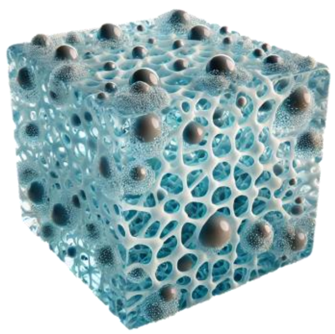

Figure 1: Schematic Illustration of a 3D graphene-based nanocomposite hydrogel structure demonstrating the graphene as a nano filler embedded within the hydrogel porous structure for enhanced conductivity.