Printable Biomimetic Nanocomposite Enabling Ultrasensitive, Durable and Wearable Strain Sensors

Jiajie Liang* and Yongsheng Chen

School of Materials Science and Engineering, National Institute for Advanced Materials, Nankai University, Tianjin 300350, PR China (Email: liang0909@nankai.edu.cn)

Abstract

The development of wearable strain sensors with simultaneous large stretchability (strain >55%) and high sensitivity (gauge factor >100) remains a grand challenge to this day. Drawing on inspiration from nature, nacre has demonstrated outstanding mechanical properties, especially combining high strength and toughness, which is due in part to its delicate hierarchical layered architecture with rich interfacial interactions. We demonstrate that strain sensors based on printable nanocomposite with nacre-mimetic microscale "brick-and-mortar" architecture can simultaneously achieve ultrahigh sensitivity and large stretchability while performing well in linearity, reliability, long-term durability, and monotonicity. The bioinspired sensor demonstrated a gauge factor >200 over a range of working strains up to 83% and achieved a high gauge factor exceeding 8700 in the strain region of 76−83%. Owing to the synergistic effects from the high mobility of polymer chains as well as rich interfacial interaction of dynamic hydrogen and coordination bonding, the sensing nanocomposite offers rapid, repeatable and effective water-triggered self-healing for electrical response and sensing behavior, thus greatly increasing the lifetime and durability of the device. Our strategy represents a critical step forward in the continual development of wearable and durable electronics.

References

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