Breakage-resistant conductive hydrogel extends service life of triboelectric nanogenerators

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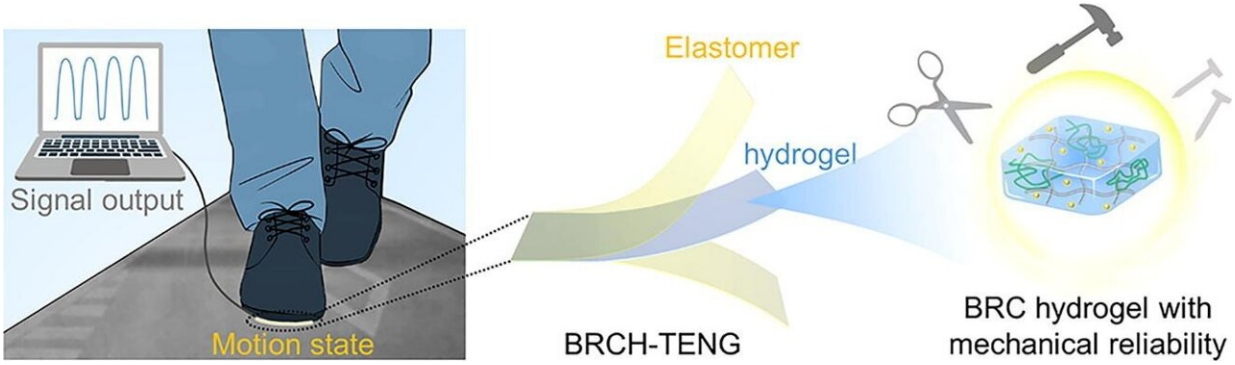

The breakage-resistant conductive hydrogel and its potential application in mechanical-reliable TENG. Credit: NIMTE

Researchers led by Prof. Chen Tao at the Ningbo Institute of Materials Technology and Engineering (NIMTE) of the Chinese Academy of Sciences (CAS), in cooperation with researchers at Ningbo University, have developed a novel breakage-resistant conductive hydrogel (BRC hydrogel) with excellent mechanical reliability, extending the service life of triboelectric nanogenerators (TENGs). This study was published in the *Chemical Engineering Journal*.

Benefitting from the facile fabrication, multiple structures, stable output and high energy conversion efficiency, TENGs have provided effective

energy supply for the continuous operation of the Internet of Things (loT) system. Among them, hydrogel-based TENGs (H-TENGs) shows great advantages in the field of flexible wearable devices and self-powered applications. However, the poor mechanical properties of hydrogel electrode lead to a low mechanical reliability during the long-term operation, thus shortening the service life of H-TENGs.

Based on the Hofmeister effect on starch polymers, the researchers developed a facile and efficient solvent-exchange strategy to prepare BRC hydrogels with ultrahigh mechanical reliability. The formation of the bundling starch chains endows the BRC hydrogel with excellent modulus of ~0.87 MPa, fracture energy of 7.45 kJ/m^2, anti-puncture capacity of ~15 Mpa and long-term stability.

In addition, the electrical properties for the BRC hydrogel have improved remarkably, since abundant free ions (i.e. Na^+, Cit^-) were introduced into the BRC hydrogel.

Employing this BRC hydrogel as electrode material, the researchers fabricated the BRC hydrogel based TENG (BRCH-TENG) with excellent electrical output performances and mechanical safety. The stable mechanical property under continuous physical impact contributes to improving the long-term stability of the BRCH-TENG, thus prolonging its service life upon accidental physical impact.

Furthermore, the fabricated BRCH-TENG shows bright and broad application prospects in the field of walking energy harvesting, real-time motion stride detection and information communication.

More information: Rui Li et al, Breakage-resistant hydrogel electrode enables ultrahigh mechanical reliability for triboelectric nanogenerators, *Chemical Engineering Journal* (2022). DOI: 10.1016/j.cej.2022.140261

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