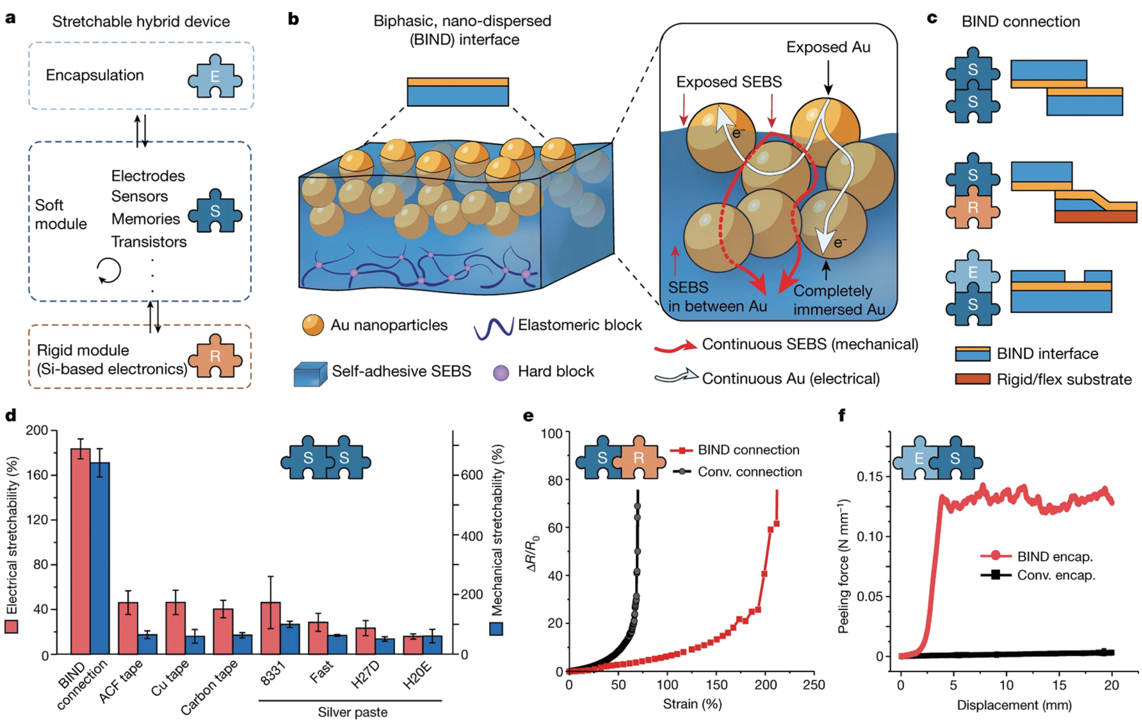
Stretchy Electronic Devices Assembled in a Lego-like Way

By YAN Fusheng (Staff Reporter)

Stretchable electronics, which can function under mechanical deformations such as stretching, bending, or twisting, are comprised of various functional modules. However, the connections between these modules are often fragile, limiting the device's overall robustness.

As reported in *Nature* on February 15, a research team, jointly led by Prof. LIU Zhiyuan at the Shenzhen Institute of Advanced Technology (SIAT) of the Chinese Academy of Sciences, Prof. Zhenan Bao at Stanford University, and Prof. Xiaodong Chen at Nanyang Technological University, have developed a biphasic, nano-dispersed (BIND) interface that can reliably connect soft, rigid, and encapsulation modules in a Lego-like way.

The BIND interface is made of two interlocking materials: a soft, non-conductive elastic polymer matrix and conductive metal nanoparticles. The two components of the interface allow for a mechanical connection through the polymer and a continuous electrical connection through the nanoparticles. This results in a highly robust and stretchable connection, providing stability during mechanical deformation.



BIND connection for stretchable hybrid device. (Credit: *Nature*)

The scientists demonstrated the effectiveness of BIND interfaces by creating two example devices: a stretchable implantable device for measuring nerve activity in living animals and a stretchable device worn on the skin to collect electrical signals from muscles. Both devices proved to be more robust than their commercial-paste counterparts and took only 10 minutes to assemble.

The BIND interface technology is compatible with various conductive materials, module configurations, and assembly environments. It has many potential applications, including implantable or skin-surface stretchable devices, as well as a shift towards modular systems in stretchable electronics. This could improve productivity and efficiency in developing these devices.

"The authors' interface technology combines the high electrical conductivity of metal nanoparticles with the self-healing property of a polymer material, thereby providing, simultaneously, outstanding mechanical stability and electrical robustness at the interface," comments ZHANG Yihui at Tsinghua University who is not involved in this work.

"The technology provides a timely solution to the long-standing challenge of creating robust electrical-interface connections in flexible electronic devices. The technology can meet various connection requirements, paving the way for many applications, including those requiring on-skin or implantable electronics".

However, there are a few limitations to the current technology. BIND connections cannot be separated without damage, limiting the reuse of individual modules. The relatively low conductivity at the connections also impedes their use in low-energy devices that require minimized electrical power. Moreover, the spatial resolution with which BIND connections can be fabricated is relatively low, necessitating a more compact metal nanostructure for functions that require high resolution.

In the future, the research team will focus on combining the BIND interface platform with low-cost and large-scale fabrication techniques, such as printing, developing reversibly adhesive materials, and utilizing more-conductive materials like liquid metal to reduce power consumption.

Reference

Jiang, Y., Ji, S., Sun, J., Huang, J., Li, Y., Zou, G., . . . Chen, X. (2023). A universal interface for plug-and-play assembly of stretchable devices. *Nature, 614*(7948), 456-462. doi:10.1038/s41586-022-05579-z