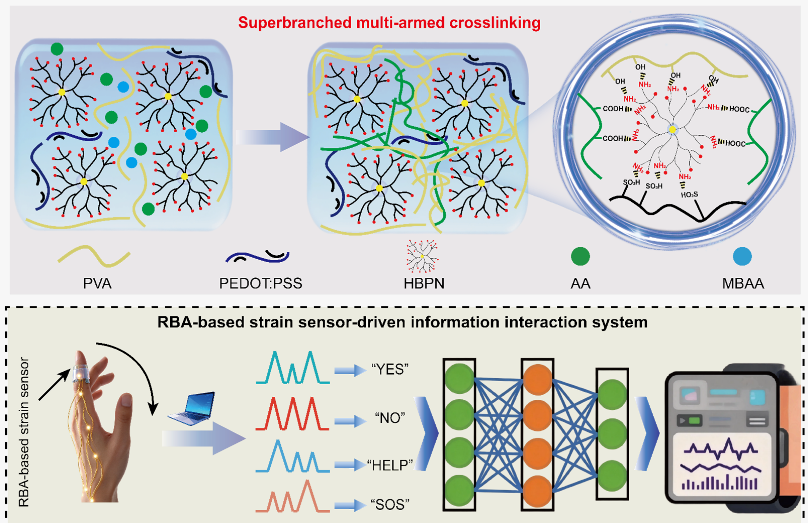
Branched web makes hydrogel sensors tougher for Morse-code interaction

GA, UNITED STATES, June 4, 2026 /EINPresswire.com/ -- Researchers have developed tough, conductive RBA hydrogels using a hyperbranched multi-arm crosslinking strategy. The hydrogels form a dense, stable network that enables wearable sensors to monitor full-body motion and support Morse-code-based human–machine interaction.



Design and applications of the RBA conducting polymer hydrogel.

From smartwatches to fitness trackers, wearable devices are becoming part of everyday life. Hence, their sensors must remain reliable as they bend and stretch with the body. Many conductive hydrogels-soft, water-rich materials well suited for skin-contact sensors—face a "toughnes-conductivity" trade-off: they may stretch easily but lose electrical signal stability, or conduct well but lack the mechanical durability needed for repeated use.

In a study published in the KeAi journal Wearable Electronics, researchers from China developed hydrogels with a robust branched architecture (RBA) by introducing a highly branched polymer into a PEDOT:PSS-based hydrogel system. This created a denser web of molecular connections, allowing the materials to stay intact under strain while preserving pathways for electrical signals.

"Wearable sensors must move with the body while keeping signals stable," says corresponding author Baoyang Lu, a professor at Jiangxi Science & Technology Normal University. "By building a denser branched network, we made the hydrogels more resistant to deformation while preserving pathways for electrical signals."

The RBA hydrogels can stretch to more than three times their original length while remaining mechanically stable. The hydrogels were sandwiched between protective layers to reduce water loss and maintain stable electrical responses during repeated use. When used as strain sensors, the resulting devices detected subtle facial movements such as smiling, as well as larger motions of the fingers, elbows and knees. They also distinguished walking, jogging and running in real time.

Beyond motion tracking, the sensors were also used in a non-verbal communication system. When attached to a finger, they converted movements into Morse-code-like electrical patterns. With a lightweight machine-learning model, the system recognized commands such as "YES," "NO," "HELP" and "SOS" with 96.26% accuracy.

"This approach could support future wearable systems for health monitoring, rehabilitation and human–machine interaction, especially when speech or movement is limited," Lu adds. "Our study offers a simple route to tougher, more reliable hydrogel sensors."

References
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