Materials

A New Way to Prepare Shape-adaptable 3D Flexible Electronics

Over the past few decades, flexible electronics have offered compelling solutions to neural recording and stimulation devices. They have contributed extensively to medical applications such as deep brain stimulators, heart pacemakers and retinal prosthesis, and have been used in neurological rehabilitation, brain science, etc. It makes flexible electronics a powerful tool for both treatment and research. They are able to not only monitor in-vivo biological signals, but also deepen and broaden the study of biological systems. However, effective contact between flexible electronics and soft biological tissues, which have different surface curvatures for medical applications, has long been a challenge.

DU Xuemin and his colleagues from the Shenzhen Institutes of Advanced Technology, Chinese Academy of Science have developed a new strategy to prepare shape-adaptable 3D flexible electronics by combining photothermally responsive poly (N-isopropylacrylamide)/gold nanorods (PNIPAM@AuNRs) composite hydrogels with conventional flexible microelectrode arrays (fMEAs).

The fMEAs-functionalized composite hydrogels are shape-adaptable and can accommodate different surface geometries. Triggered remotely in seconds by near-infrared (NIR) light at a wavelength of 808 nm, the composite hydrogel layer grafted on the back side of the fMEAs shrinks to induce a desirable shape transformation in the fMEAs. By patterning the responsive hydrogel layer, the fMEAs can exhibit planar-to-twisted structural transformations in response to an external stimulus as a result of differential shrinkage and their elastic moduli.

This strategy not only enabled fMEAs to modify their shapes to remotely accommodate unpredictable shapes of different surfaces by irradiation with NIR, but also provided multiple architectures of 3D fMEAs upon stimulation. These photothermally responsive composite-hydrogel-based fMEAs may lead to new methods to develop wearable and implantable devices and to deepen our understanding of the biological systems.

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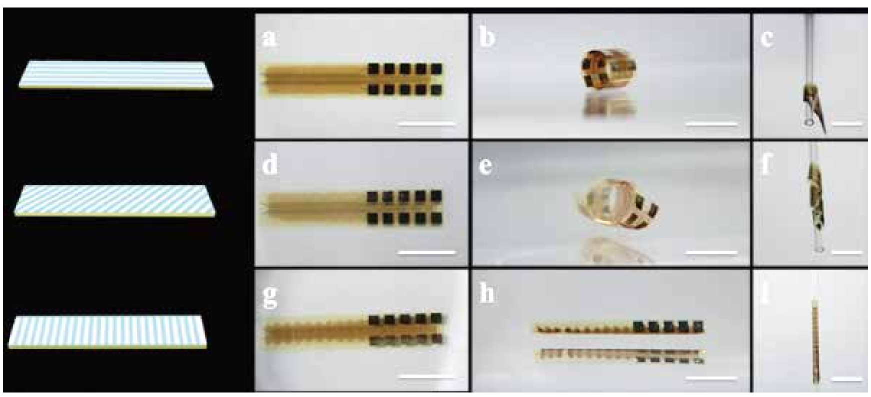

Self-twisted 3D fMEAs produced by designing the PNIPAM@AuNRs composite hydrogel layer with periodic stripes of different crosslinking densities along the parallel gel stripes, passing at oblique angles of 0°, 45° and 90°. (Credit: DU Xuemin, Shenzhen Institutes of Advanced Technology, Chinese Academy of Science)