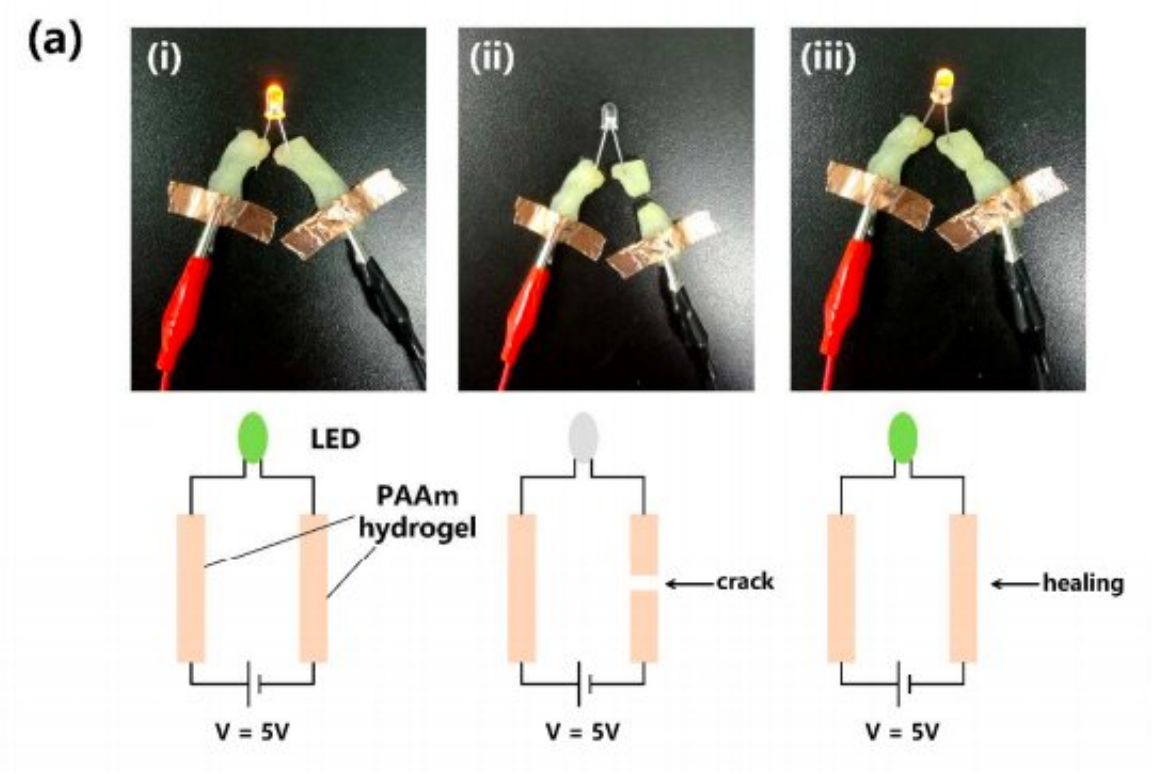
A highly stretchable and self-healing strain sensor for motion detection

July 21 2020, by Ingrid Fadelli



Credit: Hang et al.

Strain sensors are devices that can convert force, pressure, tension and weight into a change in electrical resistance (i.e., capacitance), which can then be measured. Over the past few years, these sensors have been used to create a variety of devices that can detect motion in their

surroundings, including robots, health monitoring devices and smart human-machine interfaces.

Researchers at Fudan University, Tongji University and the Chinese Academy of Sciences have recently developed a new strain sensor that is highly stretchable, efficient and sensitive to motion-related changes its environment. This sensor, presented in a paper published in Elsevier's *Nano Energy* journal, also has self-healing capabilities, as it is made of an ionic and conductive poly(acrylamide) (PAAm) hydrogel, and can quickly and effectively repair itself when torn or damaged.

"The ionic conductive PAAm hydrogel shows an excellent self-healing property with fast electrical self-healing speed (within 1.8 s) and high self-healing efficiency (99%)," the researchers wrote in their paper. "The PAAm hydrogel-based strain sensor exhibits excellent performance with large stretchability (>900%), high sensitivity (with maximum gage factor of 6.44), fast response time (~150ms) and good cycling durability (>3000 cycles)."

The new strain sensor fabricated by the researchers can monitor a variety of human motions in real time. When combined with silicon integrated circuits, it can then transfer the data it recorded directly to a smartphone or another smart device via Bluetooth.

The sensor can thus be used to monitor and keep track of human body motions, which is particularly useful for the development of health and fitness tracking devices. To demonstrate its wireless motion detection capabilities, the researchers wired one of their sensors to a printed circuit board, attached it to a human joint and then used it to record motion data.

The data it recorded was converted into a digital signal, which was controlled by an Arduino Nano microcontroller board and then

transmitted via Bluetooth to a smart phone. This data finally appeared on an app developed by Kivy.

The new strain sensor can also be used to create technology that recognizes human gestures. For instance, the researchers fabricated a smart glove that integrates five of their sensors on each finger to record information about a person's hand motions. This motion data can then be analyzed and interpreted by computational models.

Remarkably, the smart glove created by the researchers can express and recognize American sign language (ASL). This means that it could be used to enable more engaging interactions between Deaf individuals who use ASL and machines. Moreover, the smart glove can be used to wirelessly control a robotic hand, by performing the desired hand gestures while wearing the glove.

The sensing device developed by the researchers has already shown great potential for a wide range of applications, including human-machine interfaces, interactive robots, health monitoring systems and fitness trackers. In the future, it could be used to fabricate a number of new smart devices with advanced motion sensing capabilities.

More information: Cheng-Zhou Hang et al. Highly stretchable and self-healing strain sensors for motion detection in wireless human-machine interface, *Nano Energy* (2020). DOI: 10.1016/j.nanoen.2020.105064

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