Boosting the lifetime and effectiveness of biomedical devices

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A research team led by the University of Delaware's David Martin has discovered a new approach to boosting the lifetime and effectiveness of electronic biomedical devices. The discovery will help the devices better communicate with neural tissue by improving adhesion. Credit: University of Delaware

Modern electronic biomedical devices are enabling a wide range of sophisticated health interventions, from seizure detection and

Parkinson's disease therapy to functional artificial limbs, cochlear implants, and smart contact lenses.

An effective direct interfacing material is essential to communication between these devices and neural tissue, which includes nerves and the brain.

In recent years, a conjugated polymer known as PEDOT—widely used in applications such as energy conversion and storage, organic light-emitting diodes, electrochemical transistors, and sensing—has been investigated for its potential to serve as this interface.

In some cases, however, the low mechanical stability and relatively limited adhesion of conjugated polymers like PEDOT—short for poly (3,4-ethylene dioxythiophene)—on solid substrates can limit the lifetime and performance of these devices. Mechanical failure might also leave behind undesirable residue in the tissue.

Now, a research team led by the University of Delaware's David Martin has reported the development of an electrografting approach to significantly enhance PEDOT adhesion on solid substrates. The breakthrough is documented in a paper published in *Science Advances* on March 3.

Martin, the Karl W. and Renate Böer Professor of Materials Science and Engineering, explains that the term electrografting describes a process in which organic molecules are electrochemically oxidized or reduced, followed by the formation of metal-organic bonds at the substrate-polymer interface.

Compared to other methods, surface modification through electro-grafting takes just minutes. Another advantage is that a variety of materials can be used as the conducting substrate, including gold, platinum, glassy carbon, stainless steel, nickel, silicon, and metal oxides.

The actual chemistry usually takes multiple steps, but Martin and his team have developed a simple, two-step approach for creating PEDOT films that strongly bond with metal and metal oxide substrates, yet remain electrically active.

"Our results suggest that this is an effective means to selectively modify microelectrodes with highly adherent and highly conductive polymer coatings as direct neural interfaces," Martin says.

More information: "Enhanced PEDOT adhesion on solid substrates with electrografted P(EDOT-NH2)" *Science Advances*, advances.sciencemag.org/content/3/3/e1600448

Provided by University of Delaware