Researchers develop new graphite-based sensor technology for wearable medical devices

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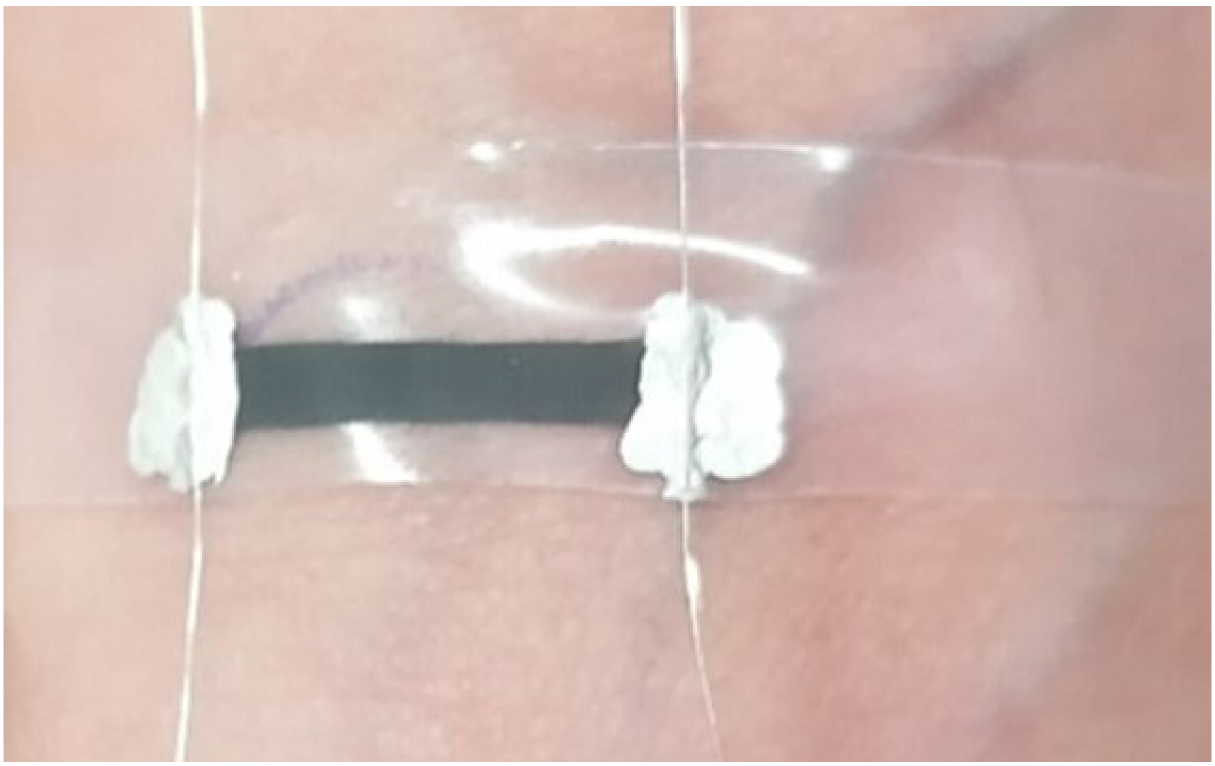

The team developed a method to formulate G-putty-based inks that can be printed as a thin-film onto elastic substrates, including band-aids, and attached easily to the skin. Credit: Trinity College Dublin

Researchers at AMBER, the SFI Centre for Advanced Materials and

BioEngineering Research, and from Trinity's School of Physics, have developed next-generation, graphene-based sensing technology using their innovative G-Putty material.

The team's printed sensors are 50 times more sensitive than the industry standard and outperform other comparable nano-enabled sensors in an important metric seen as a game-changer in the industry: flexibility.

Maximising sensitivity and flexibility without reducing performance makes the teams' technology an ideal candidate for the emerging areas of wearable electronics and medical diagnostic devices.

The team—led by Professor Jonathan Coleman from Trinity's School of Physics, one of the world's leading nanoscientists—demonstrated that they can produce a low-cost, printed, graphene nanocomposite strain sensor.

Creating and testing inks of different viscosities (runniness) the team found that they could tailor G-Putty inks according to printing technology and application.

They published their results in the journal *Small*.

In medical settings, strain sensors are a highly valuable diagnostic tool used to measure changes in mechanical strain such as pulse rate, or the changes in a stroke victim's ability to swallow. A strain sensor works by detecting this mechanical change and converting it into a proportional electrical signal, thereby acting as mechanical-electrical converter.

While strain sensors are currently available on the market they are mostly made from metal foil that poses limitations in terms wearability, versatility, and sensitivity.

Professor Coleman said:

"My team and I have previously created nanocomposites of graphene with polymers like those found in rubberbands and silly putty. We have now turned G-putty, our highly malleable graphene blended silly putty, into an ink blend that has excellent mechanical and electrical properties. Our inks have the advantage that they can be turned into a working device using industrial printing methods, from screen printing, to aerosol and mechanical deposition.

"An additional benefit of our very low cost system is that we can control a variety of different parameters during the manufacturing process, which gives us the ability to tune the sensitivity of our material for specific applications calling for detection of really minute strains."

Current market trends in the global medical device market indicate that this research is well placed within the move to personalised, tuneable, wearable sensors that can easily be incorporated into clothing or worn on skin.

In 2020 the wearable medical device market was valued at USD $16 billion with expectations for significant growth particularly in remote patient monitoring devices and an increasing focus on fitness and lifestyle monitoring.

The team is ambitious in translating the scientific work into product. Dr. Daniel O'Driscoll, Trinity's School of Physics, added:

"The development of these sensors represents a considerable step forward for the area of wearable diagnostic devices—devices which can be printed in custom patterns and comfortably mounted to a patient's skin to monitor a range of different biological processes.

"We're currently exploring applications to monitor real-time breathing and pulse, joint motion and gait, and early labour in pregnancy. Because our sensors combine high sensitivity, stability and a large sensing range with the ability to print bespoke patterns onto flexible, wearable substrates, we can tailor the sensor to the application. The methods used to produce these devices are low cost and easily scalable—essential criteria for producing a diagnostic device for wide scale use."

More information: Daniel P. O'Driscoll et al. Printable G-Putty for Frequency- and Rate-Independent, High-Performance Strain Sensors, *Small* (2021). DOI: 10.1002/smll.202006542

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