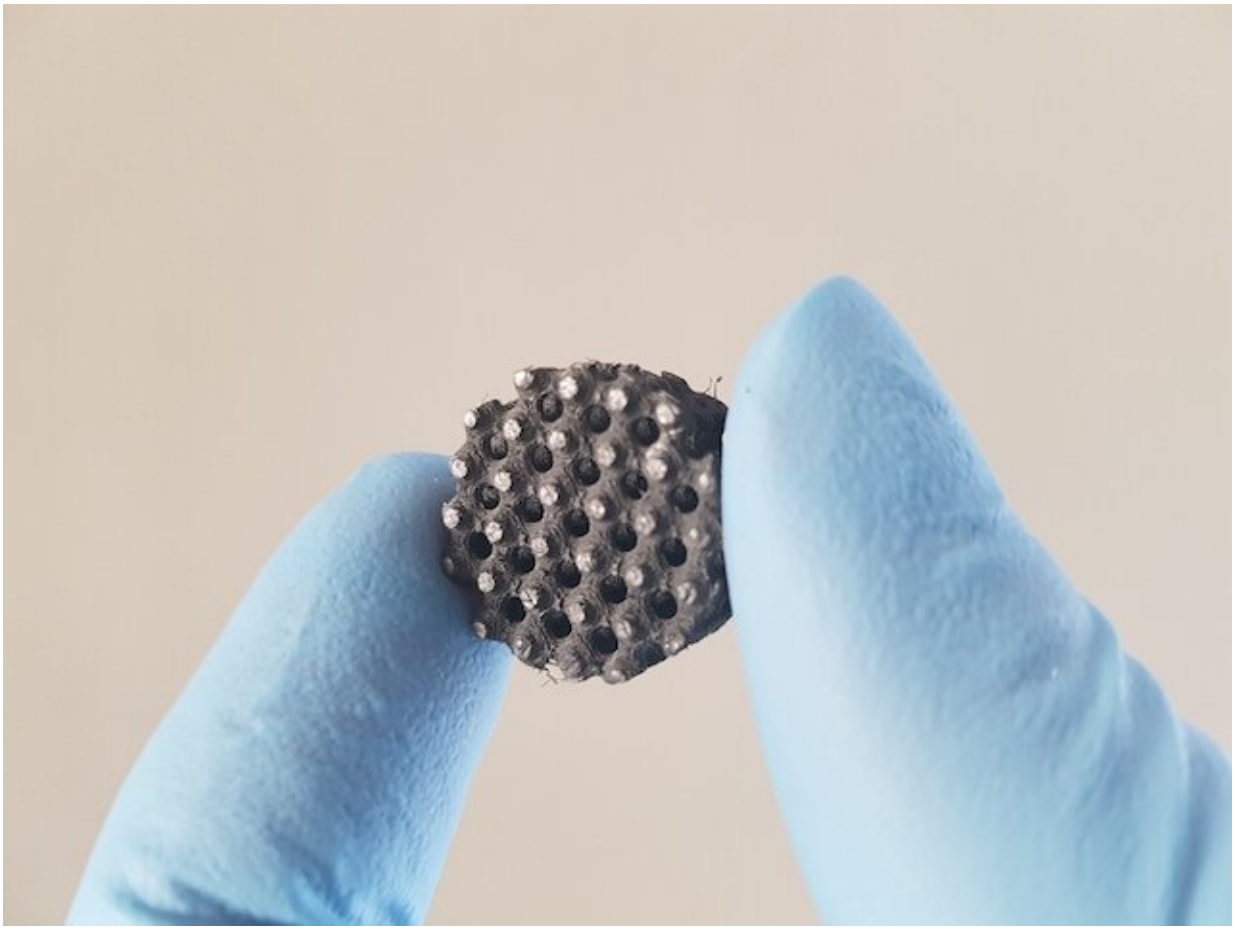
Tough, flexible sensor invented for wearable tech

March 6 2020



Credit: University of Waterloo

Researchers have used 3-D printing and nanotechnology to create a

durable, flexible sensor for wearable devices to monitor everything from vital signs to athletic performance.

The new technology, developed by engineers at the University of Waterloo, combines silicone rubber with ultra-thin layers of graphene in a material ideal for making wristbands or insoles in running shoes.

When that rubber material bends or moves, electrical signals are created by the highly conductive, nanoscale graphene embedded within its engineered honeycomb structure.

"Silicone gives us the flexibility and durability required for biomonitoring applications, and the added, embedded graphene makes it an effective sensor," said Ehsan Toyserkani, research director at the Multi-Scale Additive Manufacturing (MSAM) Lab at Waterloo. "It's all together in a single part."

Fabricating a silicone rubber structure with such complex internal features is only possible using state-of-the-art 3-D printing—also known as additive manufacturing—equipment and processes.

The rubber-graphene material is extremely flexible and durable in addition to highly conductive.

"It can be used in the harshest environments, in extreme temperatures and humidity," said Elham Davoodi, an engineering Ph.D. student at Waterloo who led the project. "It could even withstand being washed with your laundry."

The material and the 3-D printing process enable custom-made devices to precisely fit the body shapes of users, while also improving comfort compared to existing wearable devices and reducing manufacturing costs due to simplicity.

Toyserkani, a professor of mechanical and mechatronics engineering, said the rubber-graphene sensor can be paired with electronic components to make wearable devices that record heart and breathing rates, register the forces exerted when athletes run, allow doctors to remotely monitor patients and numerous other potential applications.

Researchers from the University of California, Los Angeles and the University of British Columbia collaborated on the project.

The latest in a series of papers on the research, "3-D-Printed Ultra-Robust Surface-Doped Porous Silicone Sensors for Wearable Biomonitoring," appears in the journal *ACS Nano*.

More information: Elham Davoodi et al. 3D-Printed Ultra-Robust Surface-Doped Porous Silicone Sensors for Wearable Biomonitoring, *ACS Nano* (2020). DOI: 10.1021/acsnano.9b06283

Provided by University of Waterloo