Breakthrough gives artificial muscles superhuman strength

July 11 2019

Professor Geoffrey Spinks said by placing a sheath on the muscle, "we can focus only that energy on the outer part of the fibre, and convert this input energy more quickly and efficiently." Credit: Paul Jones, University of Wollongong

Putting "socks" on artificial muscles made from inexpensive materials helps them produce 40 times more flex than human muscle, a global

research project has found, featuring researchers from the University of Wollongong (UOW) at the ARC Centre of Excellence for Electromaterials Science (ACES).

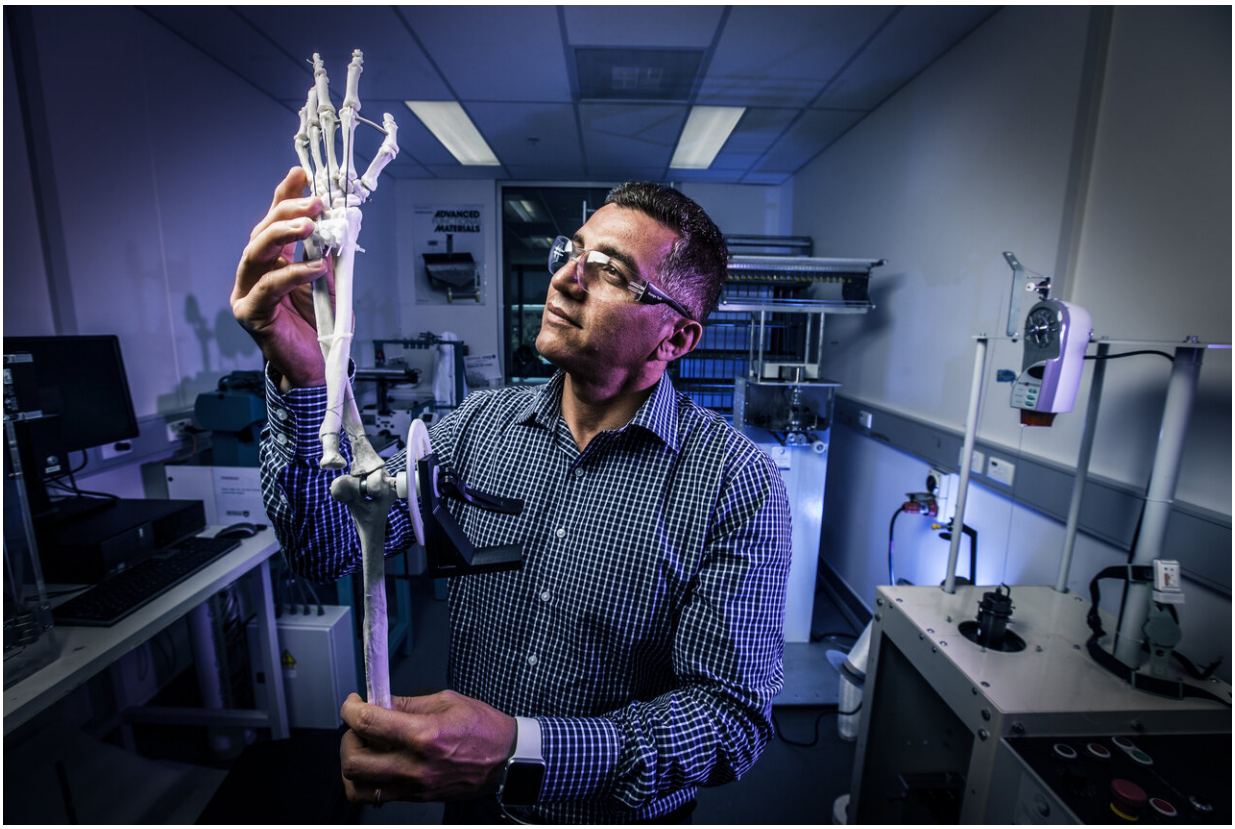
UOW researchers from ACES joined with international partners from the U.S., China and South Korea to develop sheath-run artificial muscles (SRAMs), that can be used to create intelligent materials and fabrics that react by sensing the environment around them.

It builds on the work over the past 15 years by researchers from UOW and their international colleagues who have invented several types of strong, powerful artificial muscles using materials ranging from high-tech carbon nanotubes (CNTs) to ordinary fishing line.

The latest version of the muscles feature a sheath around a coiled or twisted yarn, which contracts (or "actuates") when heated, and returns to its initial state when cooled. The outside sheath is like a close-fitting sock and absorbs energy to drive actuation of the muscle. The muscles can also operate by absorbing moisture from their surroundings.

The new SRAMs are made from common natural and man-made fibres, such as cotton, silk, wool and nylon, which are cheap and readily available.

ACES Chief Investigator Senior Professor Geoffrey Spinks said the team wanted to improve upon its previous artificial muscle work, which relied on coiling and twisting more sophisticated materials like carbon nanotube (CNT) yarn.



Dr Javad Foroughi said as well as being used as a replacement for muscles in the body, the artificial muscles could be used in smart textiles and for smart controlled drug release devices. Credit: Paul Jones, University of Wollongong

"While there's no doubt carbon nanotubes make wonderful artificial muscles, CNT is also a very expensive product. Our latest work utilises inexpensive, commercially available yarns with a CNT polymer coating for the sheath," Professor Spinks said.

"Previously, we were applying energy to the entire muscle, but only the outer part of the fibre was responsible for actuation. By placing a sheath on the muscle, we can focus only that energy on the outer part of the fibre, and convert this input energy more quickly and efficiently."

ARC-DECRA Fellow and lead Australian researcher Dr. Javad Foroughi explained that the application possibilities for SRAMs are diverse.

"When we talk artificial muscles, we're not just talking about a technology as a replacement for muscles in the body. These muscles offer some exciting opportunities for technologies where the artificial muscles intelligently actuate by sensing their environment," Dr. Foroughi said.

"Picture these muscles being woven into comfort-adjusting textiles that cool in summer and warm in winter depending on their exposure to temperature, moisture (like sweat), and sunlight, or as smart controlled drug release devices for localised drug delivery through the actuation of valves that control the flow of liquids depending on their chemical composition or temperature."

ACES Director Distinguished Professor Gordon Wallace said this work is an excellent example of the importance of global collaboration in delivering efficient, effective and high impact advances in research and innovation.

"The success of our Centre's work on artificial muscles is the result of our highly skilled researchers being important contributors to a diverse and multidisciplinary team assembled from across the globe. Building these links enables the realisation of exciting new technologies," Professor Wallace said.

This work is published in the journal *Science*, and includes collaboration by the University of Wollongong, the University of Texas at Dallas (U.S.), Donghua University (China), and Hanyang University (South Korea).

More information: J. Mu el al., "Sheath-run artificial muscles,"

Science (2019). science.sciencemag.org/cgi/doi … 1126/science.aaw2403