Team develops electronic skin as flexible as crocodile skin

March 17 2023

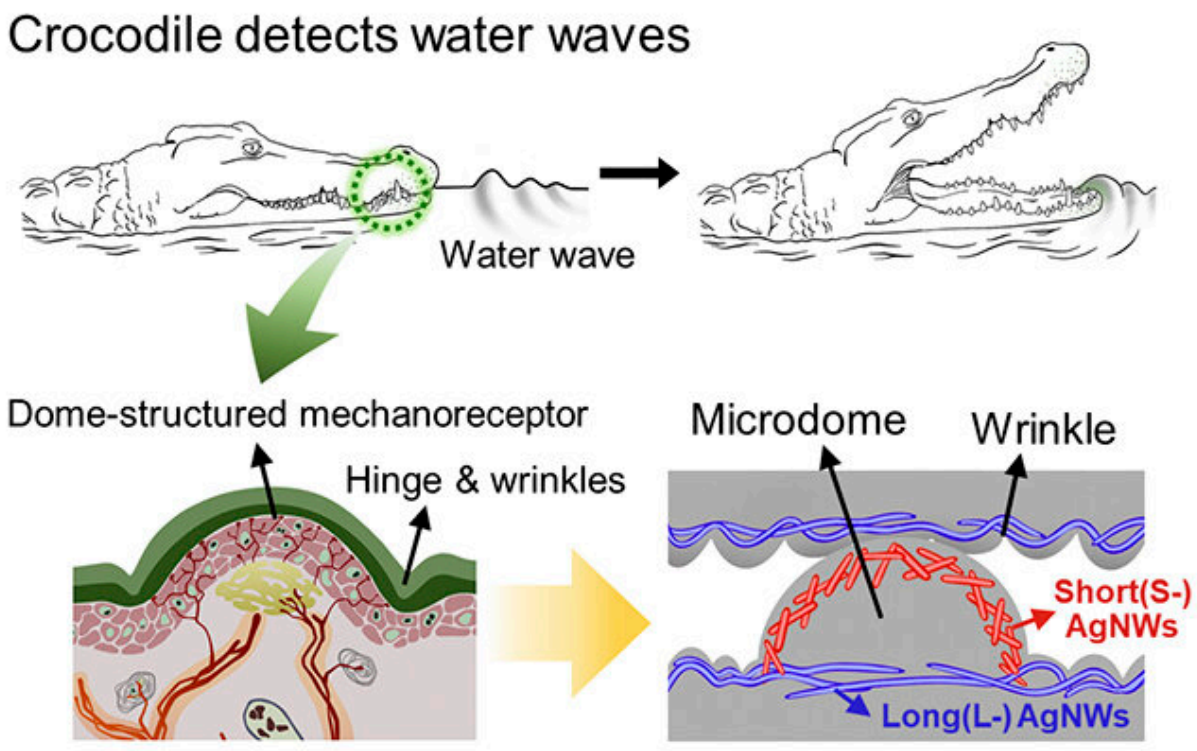


Image of a crocodile-skin-Inspired omnidirectionally stretchable pressure sensor

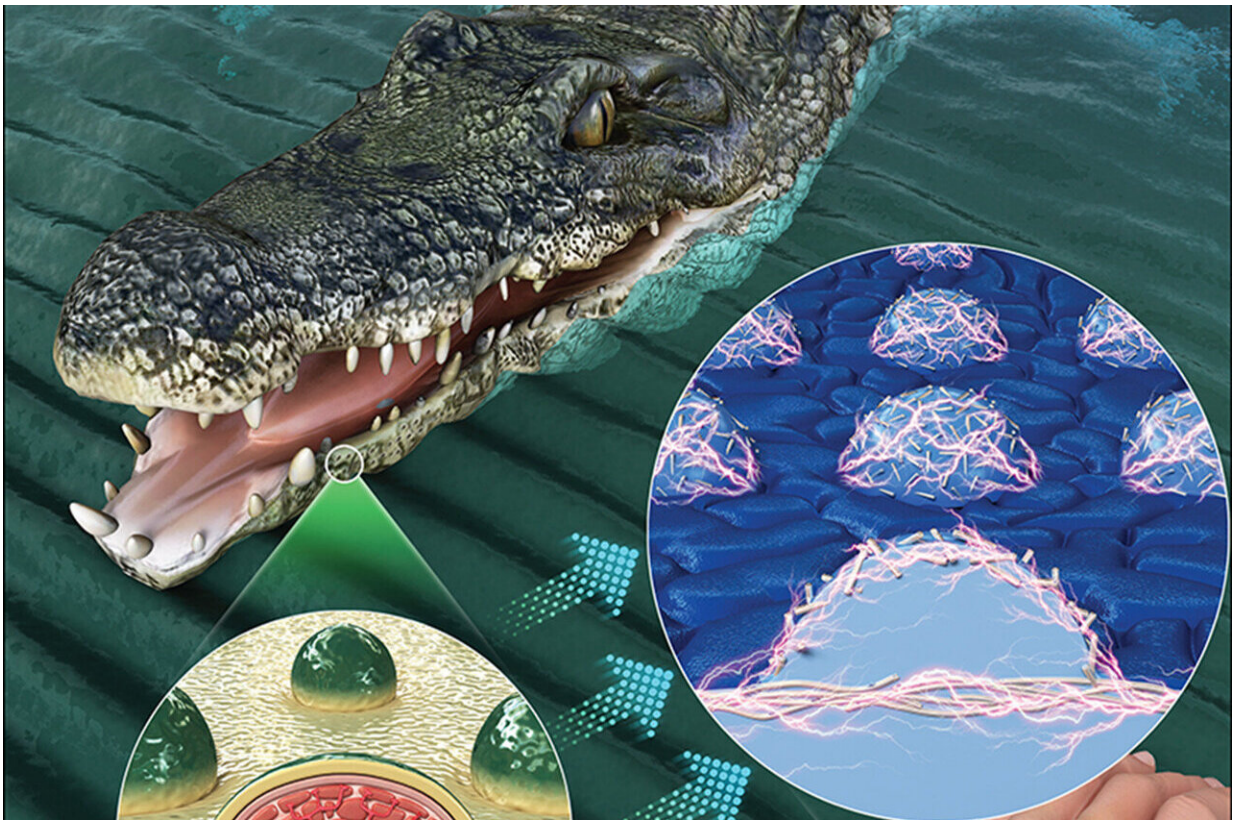
Credit: Pohang University of Science and Technology

The development of electronic skin with multiple senses is essential for various fields, including rehabilitation, health care, prosthetic limbs, and

robotics. One of the key components of this technology is stretchable pressure sensors, which can detect various types of touch and pressure. Recently, a joint team of researchers from POSTECH and the University of Ulsan in Korea has recently made a significant breakthrough by successfully creating omnidirectionally stretchable pressure sensors inspired by crocodile skin.

The team behind the research was led by Professor Kilwon Cho, Dr. Giwon Lee, and Dr. Jonghyun Son from the Department of Chemical Engineering at POSTECH, along with a team led by Professor Seung Goo Lee from the Department of Chemistry at the University of Ulsan. They drew inspiration from the unique sensory organ of crocodile skin and developed pressure sensors with microdomes and wrinkled surfaces. The result was an omnidirectionally stretchable pressure sensor.

Crocodiles, formidable predators that spend most of their time submerged underwater, possess a remarkable ability to sense small waves and detect the direction of their prey. This ability is made possible by an incredibly sophisticated and sensitive sensory organ located on their skin. The organ is composed of hemispheric sensory bumps that are arranged in a repeated pattern with wrinkled hinges between them. When the crocodile moves its body, the hinges deform while the sensory part remains unaffected by mechanical deformations, enabling the crocodile to maintain an exceptional level of sensitivity to external stimuli while swimming or hunting underwater.



On the cover of *Small*, an academic journal for materials science. Credit: POSTECH

The research team has successfully mimicked the structure and function of the crocodile's sensory organ to develop a highly stretchable pressure sensor. By inventing a hemispheric elastomeric polymer with delicate wrinkles containing either long or short nanowires, they have created a device that outperforms currently available pressure sensors. While other sensors lose sensitivity when subjected to mechanical deformations, this new sensor maintains its sensitivity even when stretched in one or two different directions.

Thanks to the fine wrinkled structure on its surface, the sensor can maintain high sensitivity to pressure even when subjected to significant

deformation. When an external mechanical force is applied, the wrinkled structure unfolds, reducing stress on the hemispheric sensing area that is responsible for detecting applied pressure. This stress reduction enables the sensor to preserve its pressure sensitivity even under deformations. As a result, the new sensor exhibits exceptional sensitivity to pressure, even when stretched up to 100% in one direction and 50% in two different directions.

The research team has developed a stretchable pressure sensor suitable for a wide range of wearable devices with diverse applications. To evaluate its performance, the researchers mounted the sensor onto a plastic crocodile and submerged it in water. Interestingly, the mounted sensor was able to detect small water waves, successfully replicating the sensing capabilities of a crocodile's sensory organ.

"This is a wearable pressure sensor that effectively detects pressure even when under tensile strain," explained Professor Cho who led the team. He added, "It could be used for diverse applications such as pressure sensors of prosthetics, electronic skin of soft robotics, VR, AR, and human-machine interfaces."

The paper outlining the research results was published in the journal *Small* and featured on the cover.

More information: Giwon Lee et al, Crocodile-Skin-Inspired Omnidirectionally Stretchable Pressure Sensor (Small 52/2022), *Small* (2022). DOI: 10.1002/smll.202270287

Provided by Pohang University of Science and Technology