Jellyfish-inspired electronic skin glows when it gets hurt

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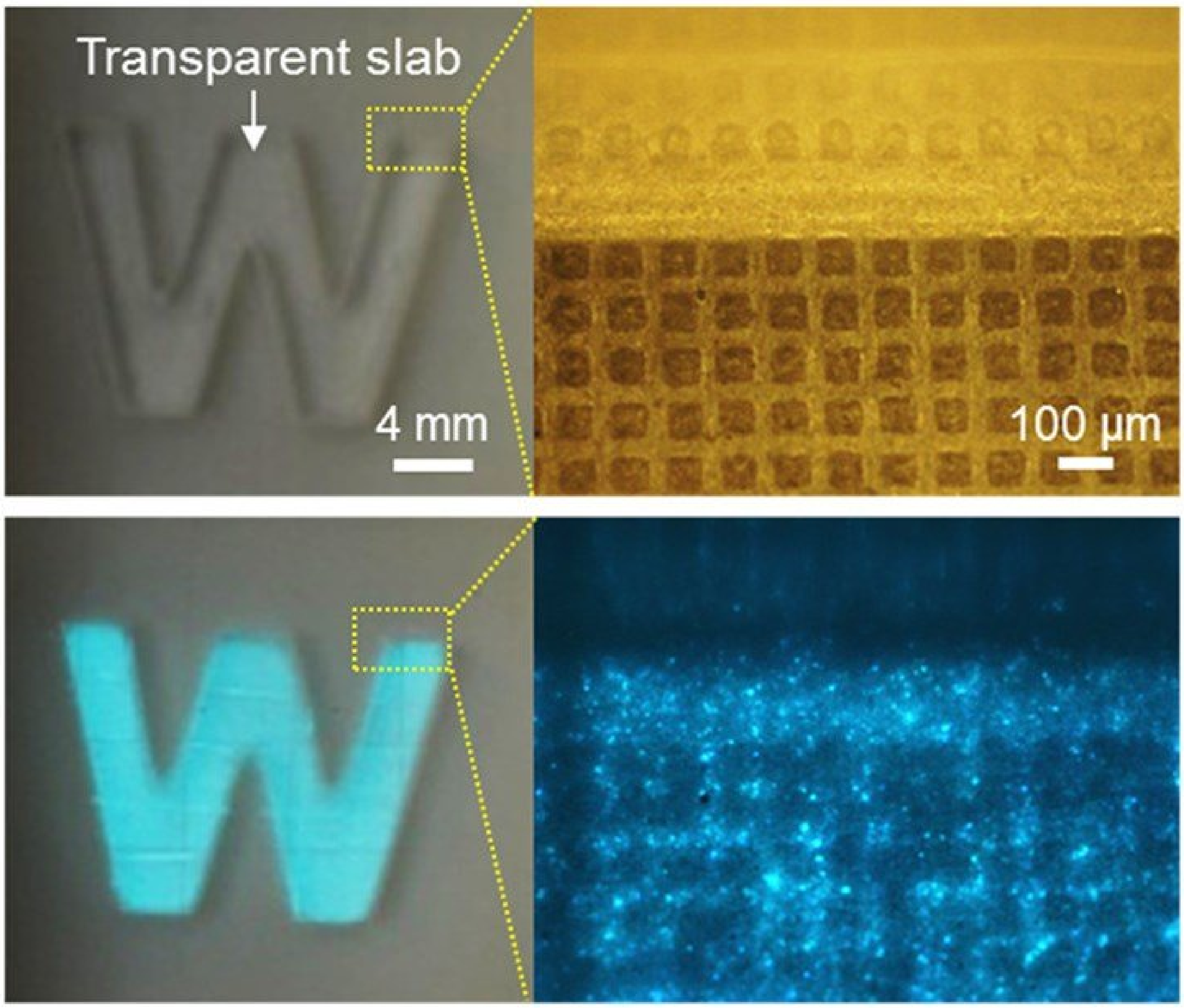
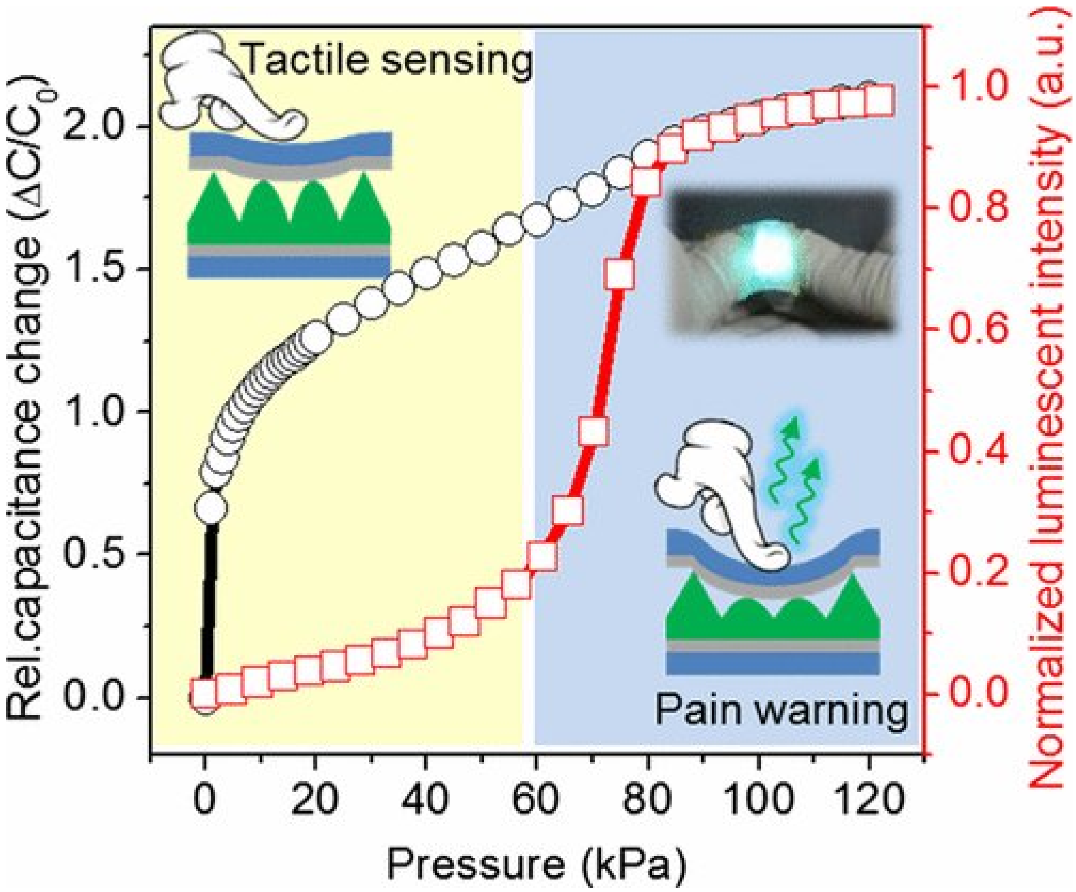


An electronic skin glows when a transparent 'W' is pressed onto it, and a voltage is applied (bottom). Credit: The American Chemical Society

Electronic-skin technologies for prosthetics and robots can detect the slightest touch or breeze. But oddly, the sensors that make this possible do not respond effectively to a harmful blow. Now researchers report in *ACS Applied Materials & Interfaces* the development of a jellyfish-inspired electronic skin that glows when the pressure against it is high enough to potentially cause an injury.

An electronic skin that can mimic the full range of biological skin's sensitivity has great potential to transform prosthetics and robotics. Current technologies are very sensitive, but only within a narrow range of weak pressures. Under high pressures that could cause damage, the electronic skins' sensitivity fades. To address this shortcoming, Bin Hu and colleagues at the Huazhong University of Science and Technology turned to the Atolla jellyfish for inspiration. This bioluminescent, deep-sea creature can feel changes in environmental pressure and flashes dramatically when it senses danger.

Building on the idea of a visual warning in response to a physical threat, the researchers combined electric and optical systems in a novel electronic skin to detect both slight and high-force pressures. They embedded two layers of stretchy, poly-dimethysiloxane, or PDMS, film with silver nanowires. These layers produce an electrical signal in response to slight pressures, such as those created by a breeze or contact with a leaf. Sandwiched in between the silver nanowire electrodes is a PDMS layer embedded with phosphors. This layer kicks in and glows with growing intensity as the physical force increases. The researchers say this approach more closely copies the wide range of pressures the human skin can feel.



Credit: American Chemical Society

More information: Yanli Zhang et al. Dual-Mode Electronic Skin with Integrated Tactile Sensing and Visualized Injury Warning, *ACS Applied Materials & Interfaces* (2017). DOI: 10.1021/acsami.7b13016

Abstract
Mimicking the pressure-sensing behavior of biological skins using electronic devices has profound implications for prosthetics and medicine. The developed electronic skins based on single response mode for pressure sensing suffer from a rapid decrease in sensitivity with the increase of pressure. Their highly sensitive range covers a narrow part of

tolerable pressure range of the human skin and has a weak response to the injurious high pressures. Herein, inspired by a bioluminescent jellyfish, we develop an electronic skin with dual-mode response characteristics, which is able to quantify and map the static and dynamic pressures by combining electrical and optical responses. The electronic skin shows notable changes in capacitance in the low-pressure regime and can emit bright luminescence in the high-pressure regime, which, respectively, imitates the functions of the mechanoreceptors and nociceptors in the biological skin, enabling it to sense gentle tactile and injurious pressure with sensitivities up to 0.66 and 0.044 kPa–1, respectively. The complementary highly sensitive sensing ranges of the electronic skin realize a reliable perception to different levels of pressure, and its mechanically robust and stretchable properties may find a wide range of applications in intelligent robots.

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