Mechanical cockroaches don 3D-printed diving suits: capable of underwater operation for 3 hours, already deployed in the Myanmar earthquake.

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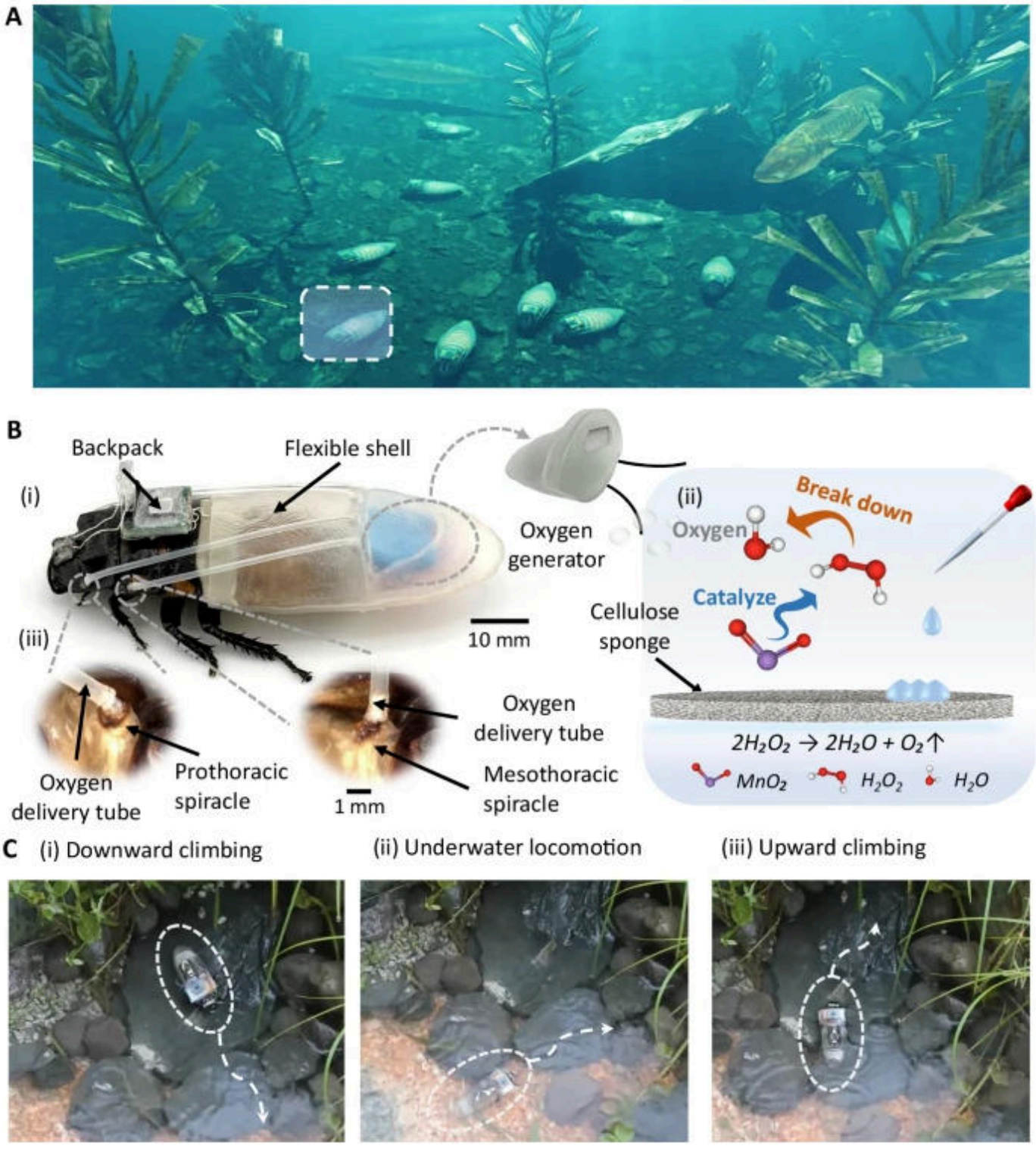
On July 7, 2026, a joint research team from Nanyang Technological University and Waseda University in Singapore developed a 3D-printed diving suit that allows a mechanical cockroach equipped with an electronic controller to perform tasks underwater. The diving suit is equipped with an oxygen generator that can continuously supply oxygen to the cockroach's respiratory system for up to three hours.

Why dress cockroaches in diving suits?

The principle behind robotic insects isn't complicated: micro-electronic controllers are implanted in live insects, controlling their movement via electrical signals. They also carry sensors and cameras for reconnaissance. This eliminates the need for large-capacity batteries like those in micro-robots, as cockroaches use their own muscles for efficient movement. Their size is a significant advantage, allowing them to squeeze into earthquake rubble, pipes, and narrow crevices. However, a real problem remains unresolved: after heavy rains or floods, disaster areas are often severely flooded, with drainage ditches and culverts under rubble filled with water. Without waterproofing, robotic insects can only travel on land. Nanyang Technological University's research focus has therefore shifted to enabling them to survive underwater, leading to the 3D-printed diving suit project. △The related research has been published in *Nature Communications*, titled "Mechanical insects wearing underwater suits can dive and travel on land and water for hours" (link).

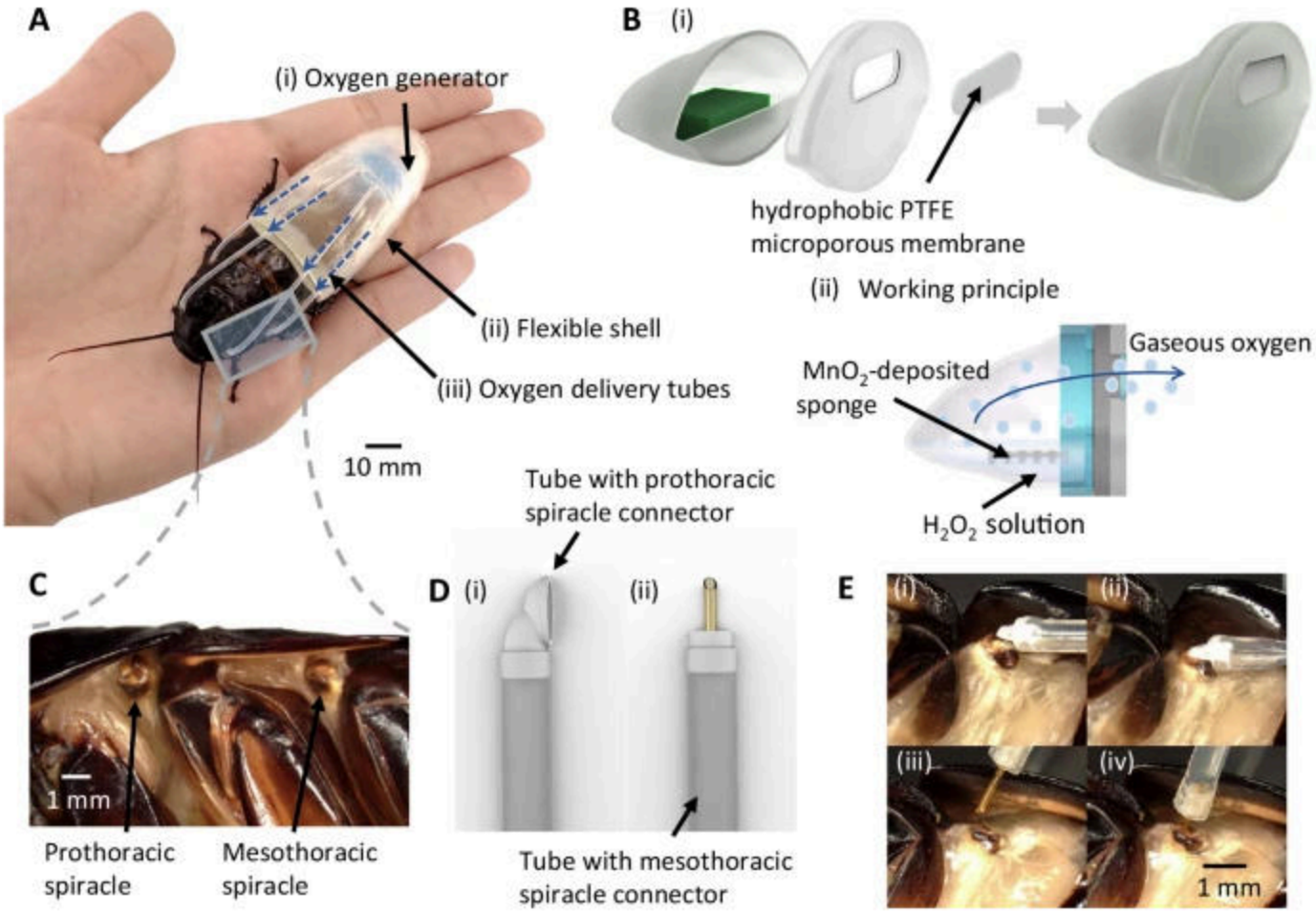
Professor Hirotaka Sato of the School of Mechanical and Aerospace Engineering at Nanyang Technological University explained, "The new diving suit

works similarly to the oxygen tanks used by human divers. It generates oxygen and delivers it directly to the insect's breathing pores, allowing the cyborg cockroach to survive and move underwater or in low-oxygen environments."



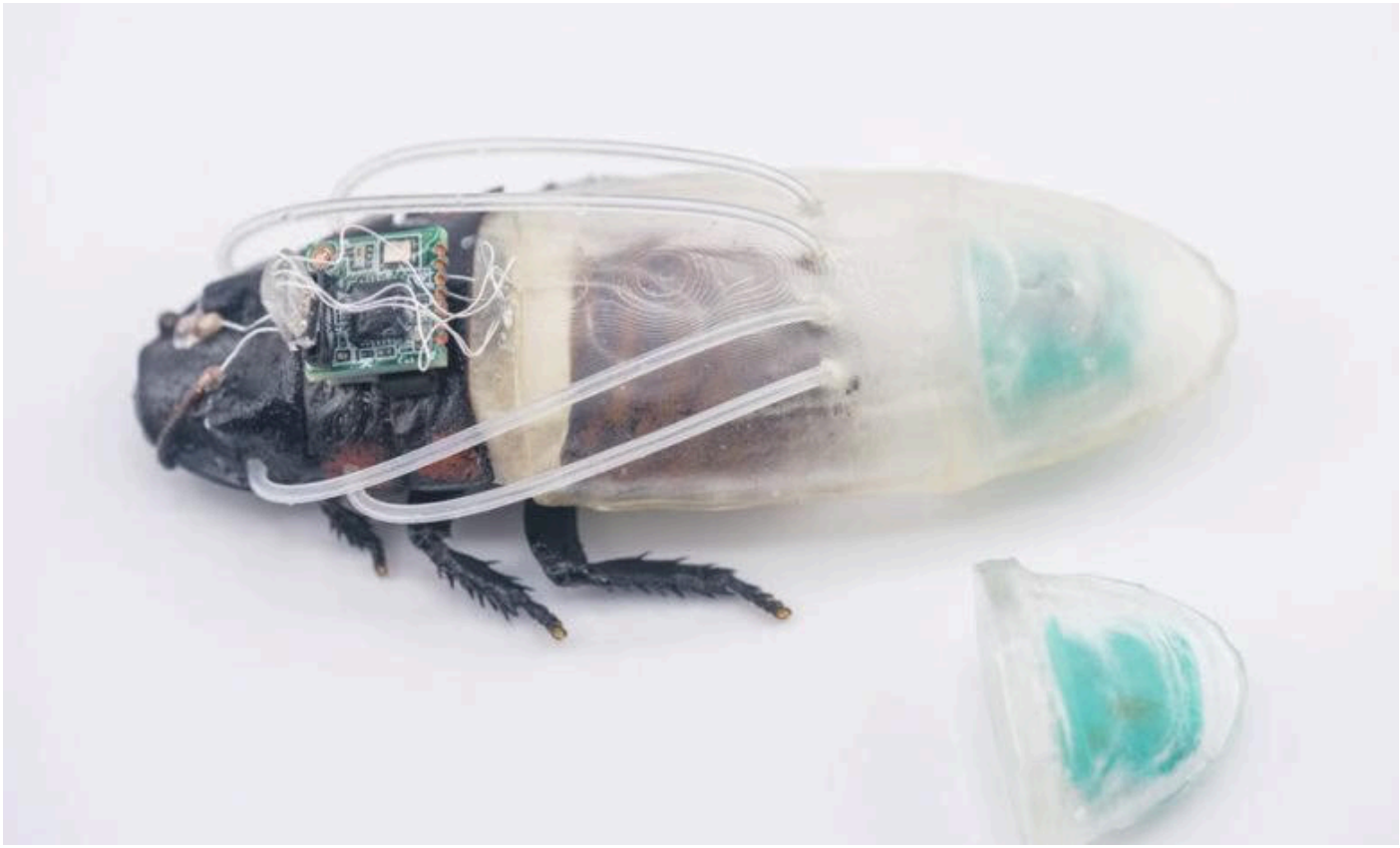
Conceptual diagram of a mechanical cockroach working underwater.

This protective suit designed for mechanical cockroaches consists of a 3D-printed oxygen generator, silicone oxygen supply tubing, and a flexible outer shell. The oxygen generator is 3D-printed from transparent PMMA resin and contains a sponge containing manganese dioxide. When it comes into contact with diluted hydrogen peroxide, the manganese dioxide acts as a catalyst to generate oxygen. The oxygen produced by the reaction of manganese dioxide and hydrogen peroxide is then delivered to the cockroach's respiratory system through the silicone tubing.



Structure and oxygen delivery mechanism of diving suit system

The device is harmless to cockroaches. As the researchers explained, the tubes attach to the cockroach's spiracles (breathing openings) and can be easily removed. In testing, the device was fitted to a modified Madagascar hissing cockroach, a relatively large, flightless species. Wearing the device, the modified insect was able to move naturally and survive in humid environments. Professor Hirotaka Sato stated, "The key engineering challenge was building a system small, lightweight, and flexible enough for the insect to wear while generating enough oxygen for extended underwater activity. Our solution combines a soft, waterproof shell with a simple yet reliable chemical oxygen generator. This allows the insect to maintain its natural mobility while entering underwater environments where it wouldn't normally be able to survive."



Professor Hirotaka Sato, who has over a decade of experience in biomimetic insect research, has already seen practical application in earthquake rescue operations in Myanmar

. Following the devastating earthquake in Myanmar this March, his mechanical cockroaches were used as part of "Operation Lionheart" to search for survivors in the rubble, marking the first real-world deployment of this technology. Currently, the research team is testing a version of the diving suit in a simulated disaster environment, planning to complete adjustments and improvements before official deployment. The underwater capabilities open up a whole new set of applications: inspecting damp and hard-to-access pipes, drains, tunnels, and infrastructure. Simultaneously, the team is exploring the possibility of adapting the technology to other insect species such as locusts and beetles.

Source: Antarctic Bear