

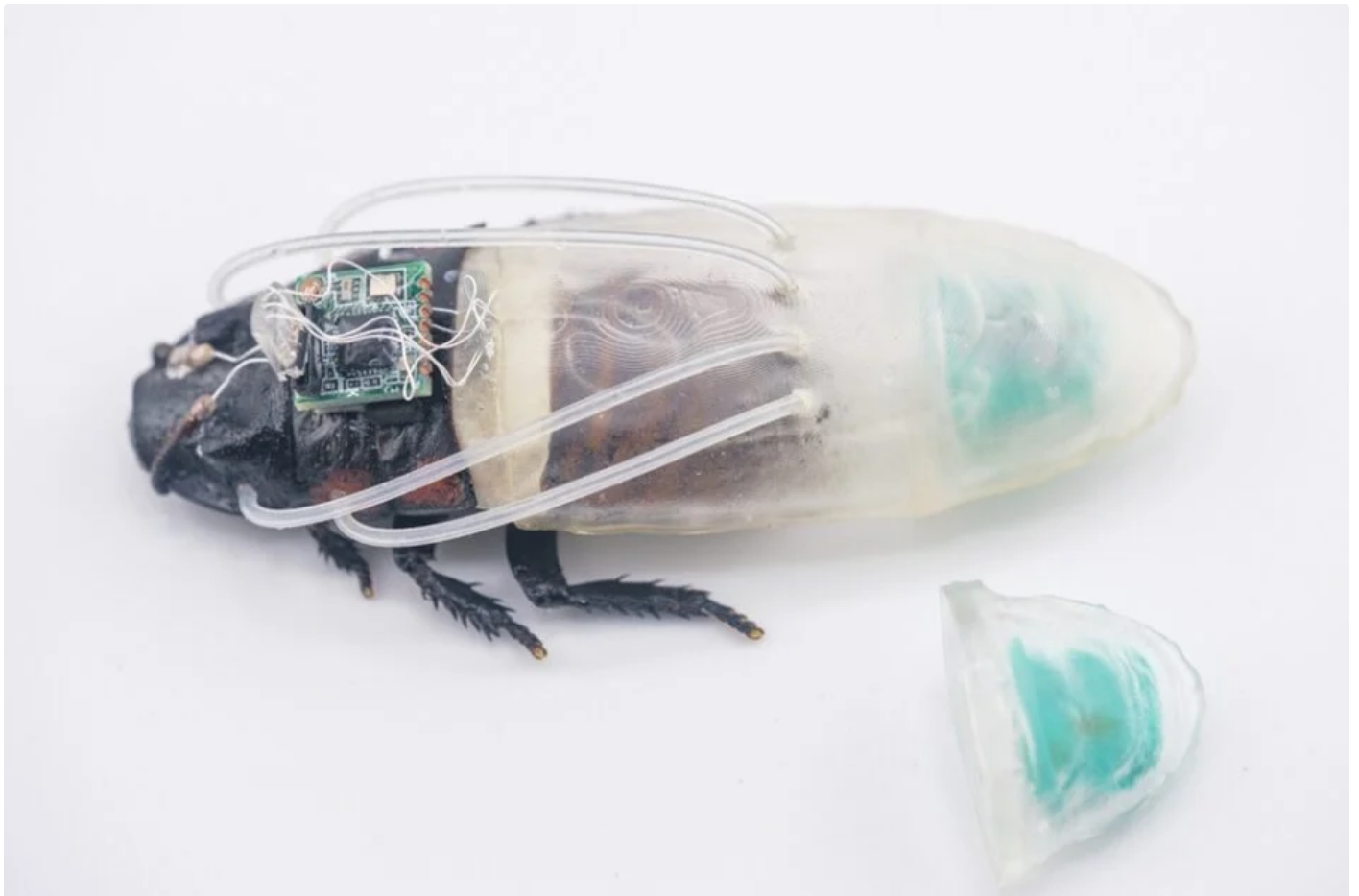
Researchers Built a Scuba Suit for Cyborg Cockroaches

The 3D-printed diving suit allowed cockroaches with electrodes attached to them to survive underwater for up to three hours.

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Scientists in Singapore and Japan have developed a tiny 3D-printed scuba suit for cyborg cockroaches, allowing them to survive and move underwater and other low-oxygen environments for up to three hours.

The suit can transform a regular cockroach, and potentially other insects, into “an amphibious cyborg robot capable of operation across land and water,” according to a new research paper published this week in *Nature Communications*. The study was conducted by scientists at Nanyang Technological University and Waseda University.

So, why do researchers want half-robot cockroaches to breathe underwater anyway?

Apparently, they hope to one day be able to use cyborg cockroaches in search and rescue missions, pipeline inspection, and other complex tasks. NTU Professor Hirotaka Sato, who led the study, has been working on cyborg insects for more than a decade. These hybrid robots combine living insects with electrodes that allow humans to remotely control their movements. Sato and his co-authors argue that this setup can make them more useful than traditional robots in some situations.

Unlike conventional robots, cyborg insects consume less energy because they use their own muscles to move. They are also small enough to move through confined and cluttered spaces that larger robots may not be able to reach.

These cyborgs have already been used in actual search-and-rescue operations, including Operation Lionheart after the 7.7-magnitude

earthquake in Myanmar in March, according to NTU.

There is one obvious drawback, though. These tiny cyborgs still have biological limits. They need oxygen, which makes them much less useful underwater.

“This is important because real disaster sites can be challenging after heavy rain or flooding, blocking access routes in the rubble, drains and narrow gaps,” Sato said in a news release on the study. “By expanding the operating parameters of our cyborg insects to include underwater travel, we believe that they can enhance search and rescue efforts.”

The new scuba suit is meant to solve that problem.

How the suit works

Cockroaches breathe through small holes on their bodies known as spiracles. To protect those spiracles from water, the researchers made a flexible 3D-printed shell that wraps around the insect’s body. Four small tubes then attach to the cockroach’s spiracles and deliver oxygen directly to them.

Attached to the shell is an oxygen-generation tank that contains a small sponge soaked in manganese dioxide. To activate the system, the team injected diluted hydrogen peroxide into the tank, then sealed it with ultraviolet adhesive to prevent leaks.

The chemical reaction inside the tank slowly releases oxygen, which is then delivered through silicone tubes into the cockroach's spiracles.

According to the study, the suit was tested on Madagascar hissing cockroaches in plastic tubes that simulated different environments.

Cyborg cockroaches equipped with the suit were able to move around underwater for two to three hours. Cockroaches in the control group suffocated within two minutes.

The team said this suit could potentially be adapted for other robot bugs like locusts and beetles, as these insects have similar body structures and respiratory systems.

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