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Physics

Unsinkable metal films can 'jump' out of water

James Urquhart

STAINLESS steel foil that normally sinks in water has been made so water-repellent that not only is it unsinkable, it appears to defy gravity by jumping out of water too.

Jiann Shieh at the National United University in Taiwan and his team chanced on the phenomenon after coating stainless steel foils thinner than a human hair with extremely water-repellent nanowires. These silica wires were grown on the steel wafers and then treated with a silicon-containing chemical called silane, which made them incredibly water-repellent.

"When we clearly saw the foil jumping out of the water after submerging it, we felt that something interesting had been discovered," says Shieh.

Usually an external force is needed for a thing that isn't alive to breach water because gravity must be overcome, as must surface tension, an elastic membrane caused by water molecules bunching tightly together at the surface where they meet air.

The team found that the source of the foil's power was the energy in surface tension, which is harvested by the nanowire coating. When the group placed the foil underwater using tweezers, it floated back up, and when it touched the surface of the water, the water-repellent wires propelled the metal into the air (*iScience*, doi.org/gkbx).

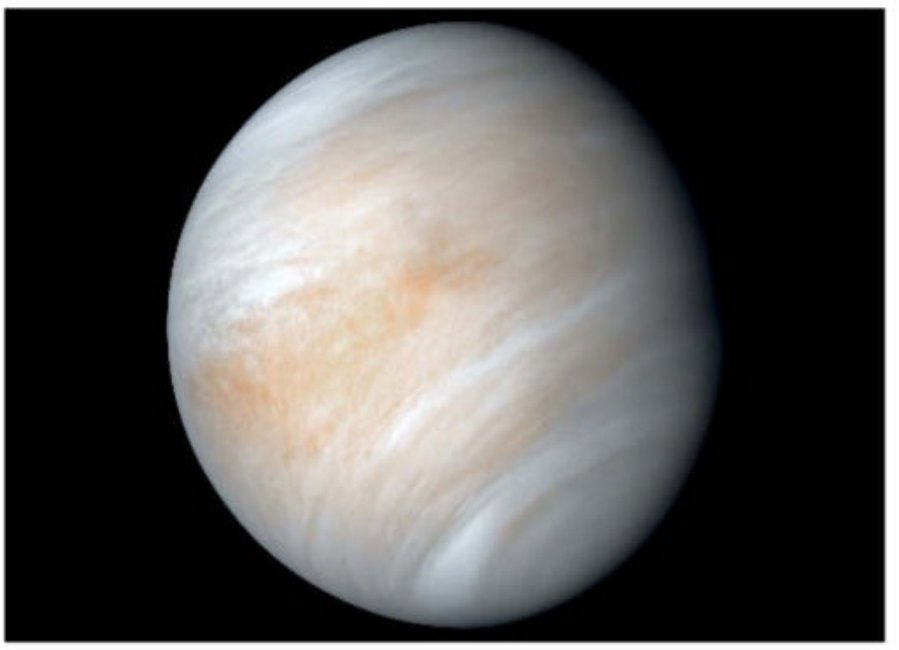
"A jumping motion that comes from the unsinkable metal converting water surface energy into motion is fascinating," says Chunlei Guo at the University of Rochester in New York, whose lab first made such metals in 2019.

Shieh's team says this reveals for the first time that power can be generated from water's surface like this. This could open new ways to separate and recycle metals in liquid, or help design small robots that can exit water, he says. ▮

Solar system

Clouds on Venus don't have enough water to support life

Leah Crane



NASA

The toxic clouds of Venus are drier than Earth's driest desert

THE clouds of Venus, which are mostly made of sulphuric acid, have far less water and far more acid than even the most extreme lifeforms on Earth would be able to survive. This is according to a new analysis of the habitability of the planet's atmosphere. The finding puts a damper on recent signs of potential life there.

In 2020, a team led by Jane Greaves at Cardiff University in the UK found evidence of a compound called phosphine in Venus's toxic clouds. On Earth, phosphine is a by-product of life, and the team couldn't come up with another way to produce it on Venus, so suggested that it could hint at life there.

However, a new study by John Hallsworth at Queen's University Belfast, UK, and his colleagues based on a combination of laboratory experiments and observations from probes sent to Venus in the late 1970s and early 80s suggests that life might be impossible in those clouds.

They based this conclusion on calculations of water activity in the clouds' droplets, a measure similar to humidity. Pure liquid water would have a water activity of 1, and perfect dryness would have a score of 0. They found a water activity of less than 0.004 for Venus's clouds, partly because acid in a droplet lowers its water activity (*Nature Astronomy*, DOI: 10.1038/s41550-021-01391-3).

0.004

Water activity in Venus's clouds on a scale of 0 to 1

This is a concentration of water 100 times below what is needed for the most resilient microorganisms on Earth, said Hallsworth in a press conference. "It's an unbridgeable distance from what life requires to be active."

In an area that arid, the membranes that hold cells together would fall apart, he said. "Even the most dry-tolerant microbe on Earth wouldn't stand a chance on Venus."

Of course, a microbe on Earth has no need to be hardy enough to survive Venus. "Literally nowhere on Earth has the extreme conditions of the clouds on Venus," says Janusz Petkowski at the Massachusetts Institute of Technology. "Those clouds are more than 100 times more dry than the Atacama desert, which is the driest place on Earth."

It is possible that life could arise on Venus that is hardier than it is here, or there could be organisms that aren't based on water at all, unlike all life that we know of.

"Certainly any Earth-like life – even our sturdiest extremophiles – would not have an easy time," says Clara Sousa-Silva at the Harvard-Smithsonian Center for Astrophysics. "But we don't know what the universal laws of biology are." Unfortunately, we also don't know how to detect non-Earth-like life.

While things aren't looking good for the potential of life floating in the Venusian clouds, there may still be a glimmer of hope. "The acidity for the Venus cloud droplets is highly uncertain," says Greaves. "It's also likely that conditions are not uniform – as on Earth – and so parts of the clouds could be much more favourable than others."

Three missions are scheduled to launch to Venus in the next decade or so, which may help unravel the mystery of the clouds' habitability. If there is life unlike that on Earth, those missions won't be able to spot it, but they will be able to clear up whether there is anywhere in the scorching atmosphere that Earth-like life could stand a chance. ▮