Artificial 'beaks' that collect water from fog: A drought solution?

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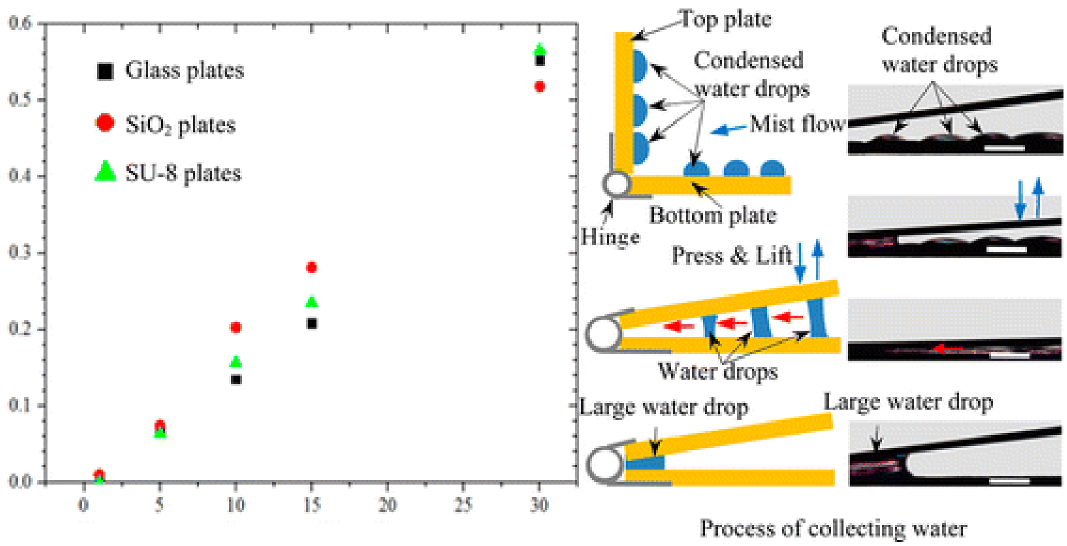

From the most parched areas of Saudi Arabia to water-scarce areas of the western U.S., the idea of harvesting fog for water is catching on. Now, a novel approach to this process could help meet affected communities' needs for the life-essential resource. Scientists describe their new, highly efficient fog collector, inspired by a shorebird's beak, in the journal *ACS Applied Materials & Interfaces*.

A UT Arlington engineering professor and his doctoral student have designed a device based on a shorebird's beak that can accumulate water collected from fog and dew.

The device could provide water in drought-stricken areas of the world or deserts around the globe.

Cheng Luo, professor in the Mechanical & Aerospace Engineering Department, and Xin Heng, PhD candidate in the same College of Engineering department, published "Bioinspired Plate-Based Fog Collectors" in the Aug. 25 edition of ACS' (American Chemical Society) *Applied Materials & Interfaces* journal. ACS also included the research in its Public Affairs Weekly release this week.

The idea began when Heng saw an article that explained the physical mechanism shorebirds use to collect their food – driving food sources into their throats by opening and closing their beaks. Luo said that inspired the team to try to replicate the natural beak in the lab.

"We wanted to see if we could do that first," Luo said. "When we made the artificial beaks, we saw that multiple water drops were transported by narrow, beak-like glass plates. That made us think of whether we could harvest the water from fog and dew."

Their experiments were successful. They found out they could harvest about four tablespoons of water in a couple of hours from glass plates that were about 26 centimeters long by 10 centimeters wide.

Shorebirds refers to a general category of bird that lives on the world's shorelines. They typically have long, hinged beaks that are designed to ferret around for prey whether in the sand or the water.

Luo said the hinged, non-parallel artificial beaks the team made in the lab mimic the shorebirds' beaks, forcing the condensation to the point where the two glass plates meet. The water is pumped through a channel, and then the process is repeated.

Luo and Heng said more sustainable methods are needed for accumulating water in arid or semi-arid places, which make up about half of the world's land mass.

"And really, if this method could be mass-produced, it could be used anywhere in the world fog or dew exist," Luo said.

Khosrow Behbehani, dean of the College of Engineering, said the research could help drought-stricken areas like Texas and California.

"The research shows innovative ideas can be triggered by careful observation of seemingly unrelated phenomenon," Behbehani said. "Collecting water from existing fog or dew using this novel method offers another alternative for communities that are strapped for our most precious resource."

More information: "Bioinspired Plate-Based Fog Collectors" ACS Appl. Mater. Interfaces, Article ASAP. DOI: 10.1021/am504457f

Abstract

In a recent work, we explored the feeding mechanism of a shorebird to transport liquid drops by repeatedly opening and closing its beak. In this work, we apply the corresponding results to develop a new artificial fog collector. The collector includes two nonparallel plates. It has three advantages in comparison with existing artificial collectors: (i) easy fabrication, (ii) simple design to scale up, and (iii) active transport of condensed water drops. Two collectors have been built. A small one with dimensions of 4.2 × 2.1 × 0.05 cm3 (length × width × thickness) was first built and tested to examine (i) the time evolution of condensed drop sizes and (ii) the collection processes and efficiencies on the glass, SiO2, and SU-8 plates. Under similar experimental conditions, the amount of water collected per unit area on the small collector is about 9.0, 4.7, and 3.7 times, respectively, as much as the ones reported for beetles, grasses,

and metal wires, and the total amount of water collected is around 33, 18, and 15 times. On the basis of the understanding gained from the tests on the small collector, a large collector with dimensions of 26 × 10 × 0.2 cm3 was further built and tested, which was capable of collecting 15.8 mL of water during a period of 36 min. The amount of water collected, when it is scaled from 36 to 120 min, is about 878, 479, or 405 times more than what was collected by individual beetles, grasses, or metal wires.

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