Scotch tape finds new use as grasping 'smart material'

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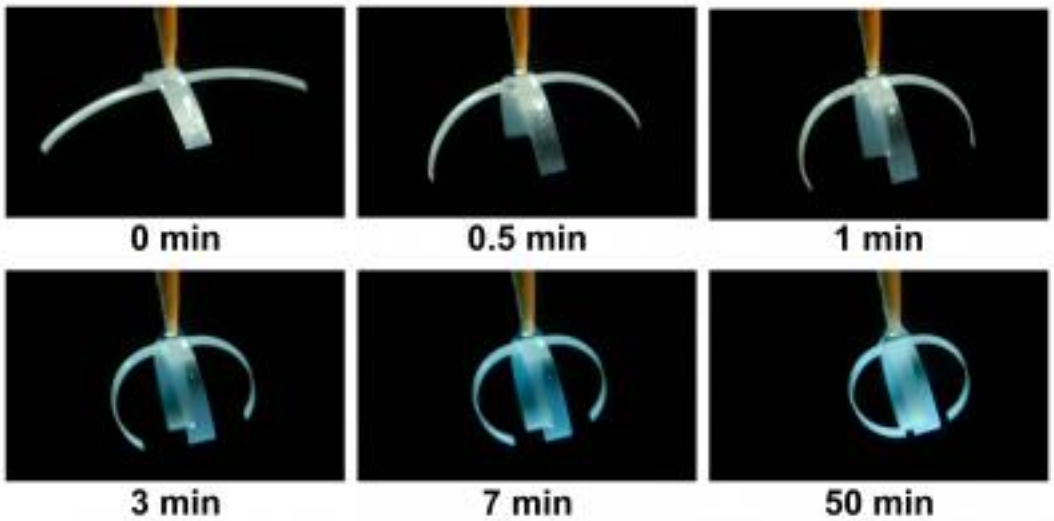

WEST LAFAYETTE, Ind. – Scotch tape, a versatile household staple and a mainstay of holiday gift-wrapping, may have a new scientific application as a shape-changing "smart material."

Researchers used a laser to form slender half-centimeter-long fingers out of the tape. When exposed to water, the four wispy fingers morph into a tiny robotic claw that captures water droplets.

The innovation could be used to collect water samples for environmental testing, said Babak Ziaie, a Purdue University professor of electrical and computer engineering and biomedical engineering.

The Scotch tape - made from a cellulose-acetate sheet and an adhesive - is uniquely suited for the purpose.

"It can be micromachined into different shapes and works as an inexpensive smart material that interacts with its environment to perform specific functions," he said.

Doctoral student Manuel Ochoa came up with the idea. While using tape to collect pollen, he noticed that it curled when exposed to humidity. The cellulose-acetate absorbs water, but the adhesive film repels water.

"So, when one side absorbs water it expands, the other side stays the same, causing it to curl," Ziaie said.

A laser was used to machine the tape to a tenth of its original thickness, enhancing this curling action. The researchers coated the graspers with magnetic nanoparticles so that they could be collected with a magnet.

"Say you were sampling for certain bacteria in water," Ziaie said. "You could drop a bunch of these and then come the next day and collect them."

Findings will be detailed in a presentation during a meeting of the Materials Research Society in Boston from Sunday (Nov. 25) to Nov. 30. Experiments at Purdue's Birck Nanotechnology Center were conducted by Ochoa, doctoral student Girish Chitnis and Ziaie.

The grippers close underwater within minutes and can sample one-tenth of a milliliter of liquid.

"Although brittle when dry, the material becomes flexible when immersed in water and is restored to its original shape upon drying, a crucial requirement for an actuator material because you can use it over and over," Ziaie said. "Various microstructures can be carved out of the tape by using laser machining. This fabrication method offers the capabilities of rapid prototyping and batch processing without the need for complex clean-room processes."

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