Soft elastomeric structures easy to fabricate using 'click-e-bricks'

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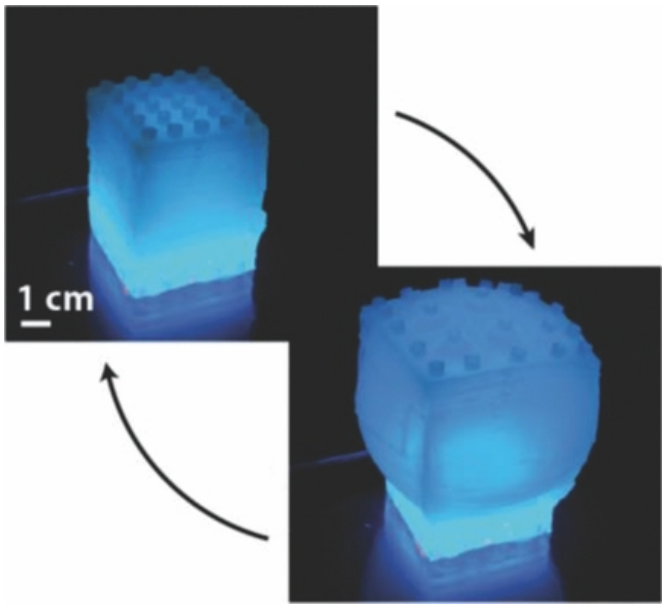

Credit: *Advanced Materials*, DOI: 10.1002/adma.201401642

Scientists from Harvard are focused on soft robots created out of bricks that go together similar to the way Lego kits work. The Harvard team has developed click-e-bricks,-but they cannot be confused with hard plastic building blocks of the well-known brand. Click-e-bricks "are stretchy, flexible, bendable, and even inflatable," said CNET. "They can be blown up like little balloons and then return to their original shape." A video shows the bricks in action, demonstrating a range of possibilities in design and function. You can see how the cube inflates; extra pieces being snapped on to the bricks; the structure stretching in different directions like a tentacle; a cylinder made from circular bricks; and how bricks with channels can be swapped to change fluid flow. The variations go on—squeezing the tube changes where light appears and the bricks could build a reconfigurable LED circuit.

George Whitesides and his colleagues at Harvard University developed a range of soft robots based on flexible plastics and powered by air—small wonder New Scientist commented that "Pliable bricks that stick together like Lego could be the ultimate play set for advanced robotics."

Jacob Aron in New Scientist had a detailed look at what the team did."Looking to Lego for inspiration," said Aron, "the team used a 3D printer to create a mould for a 6 x 9 stud brick and filled it with a flexible plastic. The material is soft, so they used a razor blade to cut bricks of different sizes from the same mould. They call their creation click-fit elastomeric bricks, or "click-e-bricks", because the studs on top click into a recess on the base of the bricks."

Taking their concept a step further, they put other materials inside the bricks, he added, noting the microfluidic channels running through to send liquids in different directions, and their temporary light with blocks containing battery and LED.

Their study, "Using 'Click-e-Bricks' to Make 3D Elastomeric Structures," was published online on July 30 in Applied Materials. The authors, Stephen A. Morin, Yanina Shevchenko, Joshua Lessing, Sen Wai Kwok, Robert F. Shepherd, Adam A. Stokes and George M. Whitesides, are from Harvard's departments of chemistry and chemical biology; Kavli Institute for Bionano Science and Technology; and Wyss Institute for Biologically Inspired Engineering. According to the publisher site, "Soft three dimensional, elastomeric structures and composite structures are easy to fabricate using click-e-bricks, and the internal architecture of these structures together with the capabilities built into the bricks themselves provide mechanical, optical, electrical, and fluidic functions."

Moving forward, said New Scientist, the team hopes soft robots will be able to manipulate the bricks themselves, leading to self-replication bots

that could swap parts in and out as needed.

At Harvard, the Whitesides Group Research focus has been on the development of new types of soft robotic structures, especially materials and methods for the fabrication of such robots. They believe their work offers rich opportunities for collaborations involving organic chemistry, soft materials science, and robotics. They also said that "Our designs use networks of channels in elastomers that inflate like balloons for actuation." Their work involves a methodology based on embedded pneumatic networks (EPNs) that they said enables large amplitude actuation in soft elastomers by pressurizing embedded channels.

Last year, their work attracted the attention of Forbes, which made the observation that scientists are exploring the fluidity and deformable nature of animals like starfish and lizards. "The ability of soft robots to climb onto textured surfaces and irregular shapes, crawl along wires and ropes, and burrow into complex, confined spaces will take them to places the hard robots of today can't venture. In the biomedical field, they could assist in surgeries, while in search and rescue missions; they could crawl into hazardous situations to aid victims."

More information: Using "Click-e-Bricks" to Make 3D Elastomeric Structures, *Advanced Materials*, Article first published online: 30 JUL 2014.
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