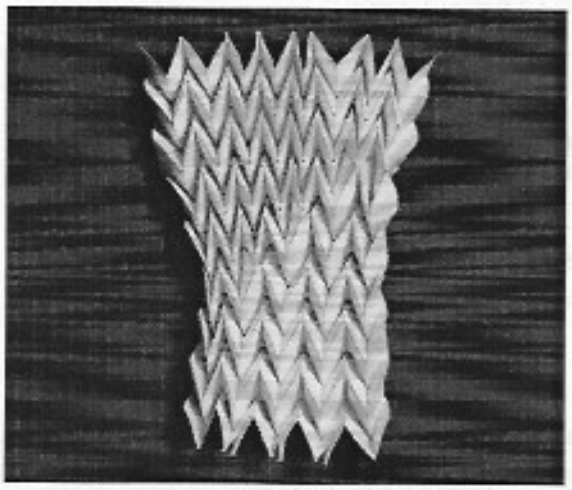
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Learning from origami to design new materials

(*Nanowerk News*) A challenge increasingly important to physicists and materials scientists in recent years has been how to design controllable new materials that exhibit desired physical properties rather than relying on those properties to emerge naturally, says University of Massachusetts Amherst physicist Christian Santangelo.

Now he and physicist Arthur Evans and polymer scientist Ryan Hayward at UMass Amherst, with others at Cornell and Western New England University, are using origami-based folding methods for "tuning" the fundamental physical properties of any type of thin sheet, which may eventually lead to development of molecular-scale machines that could snap into place and perform mechanical tasks. Results are reported today in an early online edition of *Science* ("Using origami design principles to fold reprogrammable mechanical metamaterials").



Physicists and materials scientists are using origami-based folding methods, or tessellation, for "tuning" the fundamental physical properties of thin sheets, which could help develop molecular-scale machines that snap into place and perform mechanical tasks.

At a physics meeting a couple of years ago, Santangelo mentioned the unusual properties of a special type of origami fold called Miura-ori to fellow physicist Jesse Silverberg of Cornell, a long-time origami enthusiast. Miura-ori, named after the astrophysicist who invented the technique, is a series of folded parallelograms that change the stiffness of a sheet of paper based only on the crease pattern.

Also known as tessellation, this special folding, which occurs naturally in some leaves and tissues, arranges a flat surface using a repeated pattern of alternating mountain-and-valley zigzag folds. Objects folded this way contract when squeezed, a bit like an accordion, so they

innovation due to their exotic and tunable material properties, which arise from arrangements

so multiple stable configurations can come from a single structure yielding programmable metamaterials.

Using numerical simulations, Evans and Santangelo calculated the effect that a pop-through defect has on Miura-ori. They showed that it instantly makes the entire sheet stiffer, and the effect is additive. The Cornell group will present this research at the Sixth International Meeting on Origami in Science, Mathematics and Education on Aug. 10-13 in Tokyo.

Source: *University of Massachusetts Amherst*

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