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Metallurgy of Miura-ori: lattice theory for inhomogeneous deformations of origami tessellations ARTHUR EVANS, University of Massachusetts, Amherst, JESSE SILVERBERG, LAUREN MCLEOD, ITAI COHEN, Cornell University, CHRISTIAN SANTANGELO, University of Massachusetts, Amherst — In nature, as well as in art, one often encounters thin materials that have been deformed by their environment or their creator into complex folded states; examples include the folds of the endoplasmic reticulum, the villi in the intestinal tract, and tessellated patterns in the ancient Japanese art of origami. One (engineering) advantage of creating a folded structure is that the geometric constraints associated with creasing imbues the construction with exotic mechanical properties, such as generating a material with a negative Poisson's ratio. Materials exhibiting novel behavior of this type, arising from the special properties of the unit cell, are generally classified as metamaterials. In this talk I consider a mechanical metamaterial known as Miura-ori, an origami tessellation pattern that displays soft modes and crystallographic defects not accounted for by a purely geometric theory of an infinitely thin material. I will discuss a method for deriving how inhomogeneous deformations arise from bending within Miura-ori, and show that this leads to a natural coherence length over which the inhomogeneity decays. Additionally, I will show how the modular nature of origami unit cells lends additional richness to the mechanical properties associated with deformation.

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