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Buckling-induced Planar Chirality of Porous Elastic Structure JONGMIN SHIM, SICONG SHAN, SUNG H. KANG, PAI WANG, Harvard University, BETH R. CHEN, University of Michigan, Ann Arbor, JOANNA AIZENBERG, KATIA BERTOLDI, Harvard University — We present two periodic elastomeric structures which develop planar chirality induced by buckling under uniaxial/biaxial loading. The geometry of the structure comprises a 2-D plate patterned with a regular array of circular voids. Two specific circular void arrangements are obtained by investigating buckling-induced pattern transformations for void closure. Beyond the critical load, the thin ligaments between two adjacent voids buckle leading to a cooperative buckling cascade within the 2-D plate. Both micro-scale swelling experiments and finite element simulations are used to explore the underlying mechanics in detail and to show a proof of concept of the proposed structures. During swelling, the initial non-chiral pattern of the circular voids is transformed to a deformed pattern which exhibits planar chirality through buckling-induced symmetry breaking. In order to explore the effect of planar chirality, we perform an acoustic band structure calculation at different level of deformation. The planar chirality is found to strongly affect the in-plane phononic band gaps, providing opportunities for tunable phononic band structures.

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