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Bukliball and Beyond: 3-D Soft Auxetic Metamaterials JONGMIN SHIM, Harvard University / University at Buffalo, SAHAB BABAEE, JAMES C. WEAVER, NIKITA PATEL, ELIZABETH R. CHEN, KATIA BERTOLDI, Harvard University — We present a new class of 3-D soft metamaterials whose microstructure can be dramatically changed in response to mechanical loading. Patterned spherical shells, the Bucklballs (PNAS 109(16):5978) which undergo undergoing a buckling-induced structural transformation under pressure, are employed as building blocks, and are assembled to construct 3-D super-structures. We present procedures to guide the selection of both the building blocks and their arrangement, and design materials with tunable 3-D auxetic behavior that exploit buckling as the actuation mechanism. The validity of the proposed material design is demonstrated through both experiments and finite element simulations. This pattern transformation induced by a mechanical instability opens the possibility for fabrication of 3-D auxetic materials/structures over a wide range of length scales.

Jongmin Shim
Harvard University / University at Buffalo

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