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Mechanics of Simple Cubic Auxetic Microlattices CHANGQUAN LAI, Temasek Laboratories, Nanyang Technological University, CHIARA DARAIO, Engineering and Applied Science, California Institute of Technology — The mechanical properties of a polymeric simple cubic microlattice and its auxetic variations were investigated under quasi-static and shock loading. It was found that under quasi-static loading, an increasingly negative Poisson's ratio of the microlattices led to a decrease in lattice stiffness, as well as a shift from fracture dominated failure mode to bending dominated failure mode at large strain. Because of the change in failure mode, viscous dissipation initially increased as the lattices became more auxetic, but was eventually reduced due to the decreasing lattice stiffness. Similar observations were also made for the structures under shock loading, except that shock absorption through mechanical deformation of the lattices was always found to be higher for the auxetic lattices. This is mainly due to the effect of strain hardening and the fact that the auxetic microlattices were able to distribute stresses to the horizontal trusses even at high strain rates, unlike the case with the simple cubic design. Lastly, it was also found that scaling up the designs generally decreases the stiffness, viscous dissipation and shock absorption properties of the microlattices. The insights derived from this study are expected to be useful for designing the mechanical properties of materials of a given effective density.

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