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Mechanical instabilities in periodic porous elasto-plastic solids.[1]
SRIKANTH SINGAMANENI, Georgia Insitute of Technology, KATIA BERTOLDI, MIT, SEHOON CHANG, Georgia Insitute of Technology, JI-HYUN JANG, MIT, SETH YOUNG, Georgia Insitute of Technology, EDWIN THOMAS, MARY BOYCE, MIT, VLADIMIR TSUKRUK, Georgia Insitute of Technology, GIT/MIT COLLABORATION — We describe the transformation of the periodic microporous structures fabricated by interference lithography followed by their freezing below glass transition. Periodic porous microstructures subjected to internal compressive stresses can undergo sudden structural transformation at a critical strain. The pattern transformation of collapsed pores is caused by the stresses originated during the polymerization of acrylic acid (rubbery component) inside of cylindrical pores and the subsequent solvent evaporation in the organized microporous structure. The results of a non-linear numerical investigation confirm the critical role of the bifurcation of the periodic solid under compressive stresses. In striking contrast to the earlier observations of elastic instabilities in porous elastomeric solids, the elastic-plastic nature of the crosslinked periodic microstructure studied here provides for the ability to lock in the transformed pattern with complete relaxation of the internal stresses. By confining the polymerization of acrylic acid to localized porous areas complex microscopic periodic structures are obtained.

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