Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Periodic Structural Solids: Mechanics and Multifunctional Applications LIFENG WANG, Clarkson University — Triply periodic minimal surfaces have been of great interest to mathematicians, physical scientists, material scientists, and biologists. Close physical approximations to triply periodic minimal surfaces arise in a few material systems, such as block copolymers, nanocomposites, and biological exoskeletons. Here, we demonstrate the potential to design and fabricate two-component periodically ordered structures which correspond to the level set structures associated with triply periodic minimal surfaces. These structures are shown to have a unique combination of stiffness, strength, and energy absorption, as well as damage tolerance. The results provide guidelines for engineering and tailoring the nonlinear mechanical behavior and energy absorption of cocontinuous composites for a wide range of applications and further creating multifunctional materials. For example, polymeric materials which can change shape and material properties in response to external stimuli (temperature or electric field) can provide additional functionality when used as one of the phases, such as 3D shape memory. The periodic and multiphase nature of the structures also enables mechanically tunable band gap (phononic or photonic) materials, and tunable sensors in tissue engineering.

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Date submitted: 09 Nov 2011 Electronic form version 1.4