Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Honeycombs with hierarchical organization[1] AMIN AJDARI, BABAK HAGHPANAH JAHROMI, JIM PAPADOPOULOS, ASHKAN VAZIRI, Northeastern University — We investigated the mechanical behavior of two-dimensional hierarchical honeycomb structures using analytical, numerical and experimental methods. Hierarchical honeycombs were constructed by replacing every three-edge vertex of a regular hexagonal lattice with a smaller hexagon. Repeating this process builds a fractal-appearing structure. The resulting isotropic in-plane elastic properties (effective elastic modulus and Poisson's ratio) of this structure are controlled by the dimension ratios for different hierarchical orders. Hierarchical honeycombs of first and second order can be up to 2.0 and 3.5 times stiffer than regular honeycomb at the same mass (i.e., same overall average density). The Poisson's ratio varies from nearly 1.0 (when planar "bulk" modulus is considerably greater than Young's modulus, so the structure acts "incompressible" for most loadings) to 0.28, depending on the dimension ratios. The work provides insight into the role of structural organization in regulating the mechanical behavior of materials, and new opportunities for developing low-weight cellular structures with tailorable properties.

[1]This work was supported in part by the U.S. Air Force Office of Scientific Research under AFOSR YIP grant award, #FA 9550-10-1-0145 and in part by the U.S. Department of Homeland Security under Award Number 2008-ST-061-ED0001.

Amin Ajdari
Northeastern University

Date submitted: 14 Nov 2011 Electronic form version 1.4