Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Stretchable nanoparticle helical ribbons through asymmetric cross-sectional geometry ALFRED CROSBY, JONATHAN PHAM, JIMMY LAWRENCE, GREGORY GRASON, TODD EMRICK, Polymer Science & Engineering Dept., University of Massachusetts Amherst — Helical objects are ubiquitous. From macroscopic plant tendrils to nanoscopic DNA, the geometry of a coiled helix is fundamentally interesting for its mechanical energy storage and tunable mechanical properties, like the spring stiffness. To create helices on micro- and nano- length scales, it is often necessary to have bilayer materials systems or chiral structures. However, we show in thin ribbons, where the thickness is on a similar order to the elastocapillary length, that having an asymmetric cross-sectional geometry can drive helical formation. We create long, nanoparticle-based ribbons using an evaporative assembly technique called flow coating, which produces non-rectangular cross-sections on the nanoscale. When released into water, interfacial tension balances with elasticity to form spring-like structures. These helical ribbons can be extended to high strains, show good shape recovery, and can display mechanical stiffness values ranging from 10-6 N/m at low strains to 10-2 N/m when highly stretched. In addition, the mechanical properties of these structures can be predictably tuned by controlling the ribbon dimensions or the material composition.

Alfred Crosby
University of Massachusetts Amherst

Date submitted: 13 Nov 2013 Electronic form version 1.4