Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Geometry and surface controlled formation of nanoparticle helical ribbons JONATHAN PHAM, JIMMY LAWRENCE, DONG YUN LEE, GREGORY GRASON, TODD EMRICK, ALFRED CROSBY, University of Massachsuetts Amherst — Helical structures are interesting because of their space efficiency, mechanical tunability and everyday uses in both the synthetic and natural world. In general, the mechanisms governing helix formation are limited to bilayer material systems and chiral molecular structures. However, in a special range of dimensions where surface energy dominates (i.e. high surface to volume ratio), geometry rather than specific materials can drive helical formation of thin asymmetric ribbons. In an evaporative assembly technique called flow coating, based from the commonly observed coffee ring effect, we create nanoparticle ribbons possessing non-rectangular nanoscale cross-sections. When released into a liquid medium of water, interfacial tension between the asymmetric ribbon and water balances with the elastic cost of bending to form helices with a preferred radius of curvature and a minimum pitch. We demonstrate that this is a universal mechanism that can be used with a wide range of materials, such as quantum dots, metallic nanoparticles, or polymers. Nanoparticle helical ribbons display excellent structural integrity with spring-like characteristics and can be extended high strains.

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Date submitted: 21 Dec 2012 Electronic form version 1.4