Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Edge Effect of Strained Bilayer Nanofilms for Tunable Multistability and Actuation[1] ZI CHEN, NAN HU, XIAOMIN HAN, SHICHENG HUANG, HANNAH GROVER, XIAOJIAO YU, LINA ZHANG, IAN TRASE, JOHN X.J. ZHANG, Thayer School of Engineering, Dartmouth College, LI ZHANG, Chinese University of Hong Kong, LIXIN DONG, Michigan State University — Multistability, the capability of a structure to exhibit more than one stable shape, has received increasing attention due to its applications in robotics, and energy harvesters, etc. Programming multistability into nano-electromechanical systems allows for microscale manipulation, energy harvesting and robotic operation for biomedical applications. In a spontaneous scrolled Si/Cr bilayer, two stable shapes were achieved after detaching from the substrate. We employed both theoretical and computational models to study the multistable behavior of a Si/Cr micro-claw and illustrated the mechanical principles involved. Besides the biaxial strain that serves as the primary driving force, we found residual edge stresses to be inducing bistability. In both models, individual Si/Cr micro-claws consistently demonstrate either monostability or bistability as the magnitude of the edge effect is varied. Both macroscopic and microscopic experimental designs were studied, supported by analytical and finite element simulation results. The results from this study provide a means to guide the on-demand design of strained nanobelts and nanosheets with tunable multistability and actuating capability.

[1]Z.C. acknowledges the Society in Science-Branco Weiss fellowship. J.X.J.Z. acknowledges the NIH Directors Transformative Award(1R01 OD022910-01).

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Date submitted: 11 Nov 2016 Electronic form version 1.4