Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Nanotube based engine OLEG SHKLYAEV, ERIC MOCKENSTURM, Department of Mechanical and Nuclear Engineering, The Pennsylvania State University, University Park, PA, 16802-6300, USA, VIN CRESPI, Department of Physics and Materials Research Institute, The Pennsylvania State University, University Park, PA, 16802-6300, USA — We discuss a mechanism for converting electrical energy into translational motion using a variable-shape bistable carbon nanotube. Clamping one tube end open and the other one closed, we use an applied voltage to switch the tube between mostly collapsed and mostly inflated shapes. Devices based on such a double-pinned tube geometry can operate as a voltage-controlled constant-force spring, a charge-controlled harmonic spring, or an electromechanical engine performing work by coupling to a propagating collapsed/inflated transition region. Making an analogy to ideal-gas thermodynamics, constant-voltage, constant-charge, and constant-geometry operational regimes correspond to isothermal, adiabatic and isochoric processes. Constant-voltage, constant-charge, and constant-geometry processes coupled can be combined into cycles analogous to those of a heat engine. Unlike a heat engine, the tube bistability enables it to collect useful work on both inflation and collapse motions, thus eliminating the need for external forces to restore the system to its initial state during the operational cycle.

Oleg Shklyaev
Dept of Mechanical and Nuclear Engineering,
The Pennsylvania State University,
University Park, PA, 16802-6300, USA

Date submitted: 20 Nov 2011 Electronic form version 1.4