Supplementary Figures

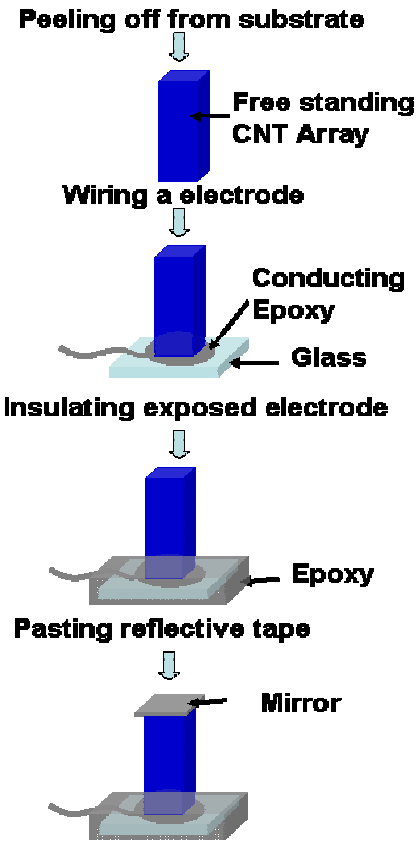

Figure S1. Fabrication steps for the nanotube tower actuator.

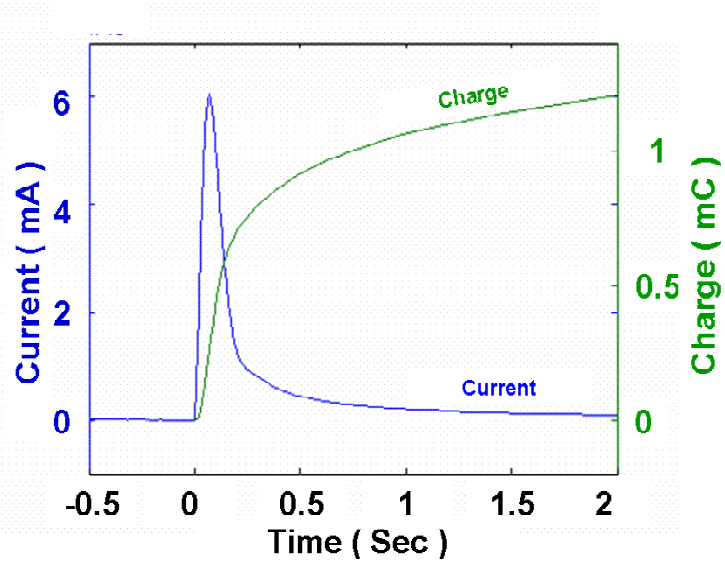

Figure S2. The potential step chronocoulogram with a 0.1 V step at 0 second and the charge plot obtained by integrating the current.

Supplementary Information.

Possible applications of the tower actuator.

Compared to the best-known ferroelectric, electrostrictive, and magnetostrictive materials, the low driving voltage of the CNT tower actuator is a major advantage for various future applications such as smart structures, multi-link active catheters, artificial muscle, micro-pumps, flaps for Micro Flying Objects, molecular motors, or nano-robots. Another advantage is direct conversion of electrical energy to mechanical energy resulting in high strain generation. The high strength and high elastic modulus of nanotubes potentially might generate large forces during actuation. Since faradaic actuators basically come from the charge-discharge-charge method like a battery, it is possible to design a self-powered actuator which means this device can actuate motion by storing capacitive charge in the nanotube structure. Power harvesting and strain sensing are other possible applications of the nanotube electrochemical tower.