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Dynamic friction force in a novel Ultra-High Frequency Oscillator
HAIBIN SU, Caltech, WILLIAM GODDARD III, Caltech — Very recently, it has been reported by Zettle group that frictional forces is very small, c.a. in the magnitude of 10-14 N per A^2, during the controlled and reversible telescopic extension of multiwalled carbon nanotubes. Moreover, a new type of nano-oscillator operating completely different from conventional quartz oscillator has been proposed based upon this interesting observation. Since then, designing this type of nano-oscillator has been carried out actively. Legoas and collaborators first simulated a 38 GHz nano-oscillator consisting of a (9,0) carbon nanotube (CN) inside of (18,0) CN. However, no successful experimental tests have been reported so far. This is probably due to the difficulty of preparing the bi-tube type oscillator unit from multiwalled carbon nanotubes with high quality, and the considerable amount of energy dissipation. We propose a new generation of fullerene nano-oscillator: a (10,10) single wall carbon nanotube with one buckyball inside. The molecular dynamics studies predict the operating frequency is ultra-high, c.a. 50 GHz. The energy dissipation from simulation shows significant effects of temperature, and impulse velocity on dynamic friction force. In particular, it has been shown that edge effects are the main cause of dynamic friction force.

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