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Phonon engineering of electronic transport in hybrid nanotubes
ALEXANDER A. BALANDIN, VLADIMIR A. FONOBEROV, Nano-Device Laboratory (http://ndl.ee.ucr.edu), Dept. of Electrical Engineering, University of California, Riverside, CA 92521 — Recently, a number of biological nanoscale objects, including tobacco mosaic viruses (TMV), have been employed as templates for assembly of inorganic nanostructures. This approach can potentially lead to a new method of fabrication of nanoelectronic circuits beyond conventional CMOS. Here we theoretically demonstrate that in addition to their role as nano-templates [1], the elastically soft TMVs can improve electron transport in the nanotubes grown on them [2]. In the simulated hybrid nanostructures, which consist of silicon or silica nanotubes on TMVs, the confined acoustic phonons are found to be redistributed between the nanotube shell and the acoustically soft virus enclosure. As a result, the low-temperature electron mobility in the hybrid TMV-silicon nanotube can increase up to a factor of four compared to that of an empty silicon nanotube [2]. Our estimates also indicate an enhancement of the low-temperature thermal conductivity in the TMV-silicon nanotube, which can lead to improvements in heat removal from the hybrid nanostructure-based circuits. The authors acknowledge the support of MARCO and its Functional Engineered Nano Architectonics (FENA) Focus Center.
[1] W.L. Liu, K. Alim, A.A. Balandin et al., Appl. Phys. Lett. 86, 253108 (2005); [2] V.A. Fonoberov and A.A. Balandin, Nano Lett. 5, 1920 (2005).

Vladimir A. Fonoberov
University of California, Riverside

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