

CHALLENGES IN MECHANICS OF ~1D MATERIALS: BULK VS SURFACE IN NANOWIRES AND NANOTUBES

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Nanotubes belong to a broader family of quasi-one-dimensional solids structures, nanowires (known previously as whiskers). However they possess a unique property of possible complete atomic homogeneity while any bulk-lattice derived ~1D object inevitably invokes at least three levels of heterogeneity: bulk, surfaces-facets, and the edges between them. This generally complicates the physics involved in even primary ground state identification, renders classical Wulff theorem insufficient, and may cause inherent instabilities similar to Rayleigh capillary instability. On the other hand, inter-structural (supra-molecular in chemistry) interactions at the nanometer scale become significant factors in macro-material behavior. They limit the material performance, mediating the transfer of intra-wire strength and stiffness into the macroscopic material property. We will discuss this multi-scale physics and present some recent results [1-5].

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