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Sliding on a Nanotube: Interplay of Friction, Deformations and Defects HSIANG-CHIH CHIU, SUENNE KIM, School of Physics, Georgia Institute of Technology , ERIO TOSATTI, International School for Advanced Studies (SISSA), and CNR-IOM Democritos, CHRISTIAN KLINKE , Institute of Physical Chemistry, University of Hamburg, ELISA RIEDO, School of Physics, Georgia Institute of Technology — Carbon nanotubes (CNT) have applications as composite material reinforcements and components in nanodevices due to their exceptional physical properties. However, CNTs have structural defects that can change their mechanical properties. For applications, CNTs have to be in contact with other surfaces, thus it is important to understand how defects change their frictional properties. Here, we show that defects can impact the frictional properties of supported Arc Discharge (AD) and Chemical Vapor Deposition (CVD) grown CNTs by sliding an AFM tip along (longitudinal) and across (transverse) the CNT axis. Larger friction coefficient is found during transverse sliding due to a lateral CNT deformation (called hindered rolling) that causes extra friction dissipation which is absent during longitudinal sliding.[1] A friction anisotropy, defined as the ratio of shear strength measured during both sliding directions, can be as high as 13.7 for AD CNTs but less than 6 for CVD CNTs. Extra defects in CVD CNTs couple both sliding motions, resulting in more energy dissipation and higher longitudinal friction. A simple analytical model is developed to explain the observed experimental behavior. Our finding provides a better understanding of tribological properties of individual CNT at the nanoscale. [1] M. Lucas et al., Nature Mater. 8, 876 (2009)

Hsiang-Chih Chiu
School of Physics, Georgia Institute of Technology

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