Frictional Response of Texture Induced Strained Graphene

Andrea Mescola[1], G. Paolicelli[1], R. Guarino[2], J. G. McHugh[3], S. P. Ogilvie[4], A. Rota[1,5], E. Gnecco[6], E. Iacob[7], S. Valeri[1,5], N. M. Pugno[8,9], M. M. Rahman[10], V. Gadhamshetty[11], P. Ajayan[10], A. B. Dalton[4], M. Tripathi[4]

[1]CNR-Istituto Nanoscienze - S3, Via Campi 213, Modena, Italy
[2]EPFL-SPC, CH-5232 Villigen PSI, Switzerland
[3]Dept. of Chemistry, Loughborough University, Loughborough, U.K.
[4] Dept. of Physics and Astronomy, University of Sussex, Brighton, U.K.
[5] Dept. of Physics, Informatics and Mathematics, University of Modena and Reggio Emilia, Italy
[6]Otto Schott Institute of Materials Research, Friedrich Schiller University Jena, Germany
[7] Fondazione Bruno Kessler Sensors and Devices, via Sommarive 18, Trento, Italy
[8] Laboratory of Bio-Inspired, Bionic, Nano, Meta, Materials & Mechanics, Dept. of Civil, Environmental and Mechanical Engineering, University of Trento, Italy
[9] School of Engineering and Materials Science, Queen Mary University of London, UK
[10] Dept. of Materials Science and Nanoengineering, Rice University, Houston, USA
[11] Dept. Civil and Environmental Engineering, SDSM&T, Rapid City, USA
andrea.mescola@nano.cnr.it

Friction-induced energy dissipation impedes the efficiency of nanomechanial devices during their relative motion. Nevertheless, modification of nanoscale interfaces, such as by application of graphene, enables modulation of frictional dissipation in such devices. This work reports on the tribology of graphene deposited on artificially corrugated silicon surfaces consisting of long parallel grooves separated by a short variable distance [1]. The morphology and the periodicity of the substrate defines the strain induced in graphene as revealed by scanning probe techniques, Raman spectroscopy [2] and molecular dynamics simulation. The presence of graphene not only lubricates the textured surface by reducing friction force a factor of ≈10 but also induced modulated friction force dissipation [3,4]. The asymmetric straining of graphene coating layer over the corrugated architecture is revealed through frictional force microscopy in two different directions, namely orthogonal and parallel to corrugation axis. Here, we show the transformation of the lubrication into an ultra-low friction force scanning parallel to the groove axis. Such frictional disparity is found to be insignificant at the bare textured system, clearly demonstrating the strain-dependent regulation of friction force. Our results are applicable for graphene, and other 2D materials covered corrugated structures with movable components such as nanoelectromechanical systems, nanoscale gears and robotics.

References

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