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Experimental observation of ballistic nanofriction on graphene[1]

BRANDON BLUE, MICHAEL LODGE, University of Central Florida, CHUN TANG, University of California, Merced, WILLIAM HUBBARD, University of California, Los Angeles, ASHLIE MARTINI, University of California, Merced, BEN DAWSON, MASA ISHIGAMI, University of Central Florida — Recent calculations [Guerra et al, Nature Materials, 9, 634 (2010)] have predicted that gold nanocrystals slide on graphite with two radically different friction coefficients depending on their speeds. At high sliding speeds in the range of 100?m/s, nanocrystals are expected to behave radically differently in what is known as the ballistic nanofriction regime. In this work, we present a direct measurement of ballistic nanofriction for gold nanocrystals on graphene. Nanocrystals are deposited onto an oscillating graphene-coated quartz crystal microbalance (QCM) in-situ under UHV and allowed to periodically ring down. After deposition, frictional parameters are measured as a function of oscillatory velocity to investigate the predicted velocity dependence of friction. Lubricity beyond even the predictions of ballistic nanofriction is observed at much lower surface velocities than expected, with drag coefficients approaching $8.65*10^{-14}$ kg/s. In comparison to the theoretically-predicted value of $2.0*10^{-13}$ kg/s, our results suggest a much lower interaction strength than proposed in contemporary models of nanoscopic sliding contacts even at relatively low speeds.

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