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Low-temperature superlubricity of suspended graphene

We study the superlubric sliding of a nanometer-sized diamond-like-carbon tip over a suspended graphene layer at different temperatures using molecular dynamics [1-5]. Dramatic effects of thermally- and mechanically-induced rippling are demonstrated on the frictional properties of free-standing graphene. The tensile deformation of graphene in response to the normal load is found to be beneficial for achieving low friction at most of the studied temperatures. However, graphene at liquid-helium temperature exhibits an inverse trend, the friction is even found to be negative at low-load. This abnormal behavior arises from the oscillation of graphene in favor of superlubricity. The breakdown of superlubricity in suspended graphene is found to be strongly correlated to the competition between the rippling and oscillation mechanisms.

References

[1] Z. Wang, to be published.
[2] Z. Wang and M. Devel, Phys. Rev. B 83 (2011) 125422.
[3] Z. Wang, Carbon 47 (2009) 3050.
[4] Z. Wang, W. Mook, C. Niederberger, R. Ghisleni, L. Philippe and J. Michler, Nano Lett. 12 (2012) 2289.
[5] W. Guo, Z. Wang and J. Li, Nano Lett. 15 (2015) 6582.

Figures

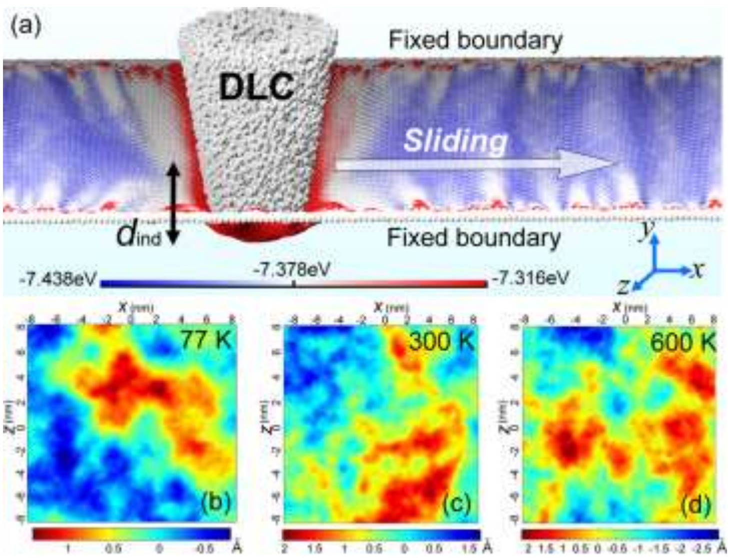

Figure 1: (a) Model setup for a DLC tip sliding over an infinite graphene layer that is suspended between two parallel hypothetical supports. (b-d) Morphology of suspended graphene at different temperatures.