Thermal effects and spontaneous frictional relaxation in atomically thin layered materials

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We study the thermal effects on the frictional properties of atomically thin sheets. We simulate a simple model based on the Prandtl-Tomlinson model that reproduces the layer dependence of friction and strengthening effects seen in atomic force microscope experiments. We investigate sliding at a constant speed as well as reversing direction. We also investigate contact aging: the changes that occur to the contact when the sliding stops completely. We compare the numerical results to analytical calculations based on Kramers rates. We find that there is a slower than exponential contact aging that weakens the contact and that we expect will be observable in experiments. We discuss the implications for sliding as well as aging experiments.

Keywords: Simulation, thermal effects, Kramers rates, friction, relaxation

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