

CAPILLARY EFFECTS ON FRICTION: FROM NANOCONFINED IONIC LIQUIDS TO SKI FRICTION

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ABSTRACT

Capillarity and surface effects may dramatically affect friction. In humid environments, capillary bridges strongly increase adhesion and thus friction between solids in contact, with manifestation in terms of ageing behavior observed in solid friction, granular sandpiles [1] or crease opening [2]. Surface properties may indeed affect the thermodynamic phase properties of a confined material and this strongly affects dissipation and the tribological behavior. Reversely, shear may lead to phase change of a confined materials, thus strongly modifying friction and capillarity in a feedback mechanism.

In this talk I will consider two examples highlighting such intricate interplay between capillarity and friction, occurring at very different scales.

First I will discuss experimental results concerning the behavior of a nano-confined ionic liquid, obtained using a tuning-fork AFM setup. Our measurements demonstrate that below a threshold confinement - in the range of tens to hundred of nanometers-, the ionic liquid undergoes an abrupt phase change towards a solid phase, leading to a huge increase in dissipation. Quite unexpectedly, this threshold thickness is measured to be intimately related to the metallic nature of the confining materials, with more metallic surfaces facilitating freezing. This behavior is interpreted theoretically in terms of the shift of the freezing transition, taking into account the influence of the electronic screening on the wetting of the ionic liquid on the confining surfaces, as described by the simple Thomas-Fermi approach [3]

In a second part, I will explore the frictional behavior of snow and in particular of the role of hydrophobic waxes on decreasing friction. While it is usually accepted that a liquid film forms under shear heating (although this fact is not properly

demonstrated experimentally), the reason why hydrophobic coatings decrease friction remains mysterious. It is however one of the key and highly sensitive ingredient for ski competitions. I will report recent experiments about snow friction and the effect of waxing, pointing to the subtle effects of capillarity on the friction process [4].

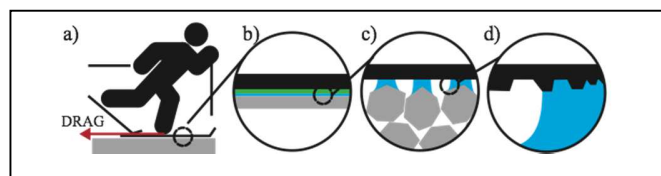


Fig.1 Ski friction and the effect of capillarity

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