Statistical Physics Perspective on Mercury Droplet Spreading on Thin Metal Films on Glass

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Droplet spreading is a fascinating complex phenomenon, as the droplet spreads, reacts and dissolves on and into metal substrates. In high temperatures, one could have a large collection of liquid metals spreading on solid metals, with many applications in industry and material science. In room temperature, the only possible similar process is a mercury droplet spreading on a silver or gold thin film on glass. When this spreading is monitored top-view, rich and nontrivial spatio-temporal patterns of the advancing interface have been observed during the process.

In this talk we discuss the spreading of tiny mercury droplets (100-150 microns) on thin metal-on-glass substrate, with silver or gold thin films in various thicknesses ($1000 - 4000 \mathring{A}$). The patterns in time and space of the advancing interface are analyzed using statistical physics and its relevant tools for the study of kinetic roughening, i.e. the growth, roughness and persistence exponents. Statistical physics exponents were calculated and sorted, thus providing insight into the complex spreading process and its dependence on the material, the film thickness, the internal morphology and the method of sample preparation.

The universality of the results has been examined by comparison with similar patterns of reactive wetting in high temperatures. More recent results for spreading on thin gold films suggest an even more complex picture of exotic instability patterns emerging towards the end of the process.

References:

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