Departamento de
Física de la
Materia Condensada
Universidad Zaragoza

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COST ACTION MP1303: Understanding and controlling nano and mesoscale friction

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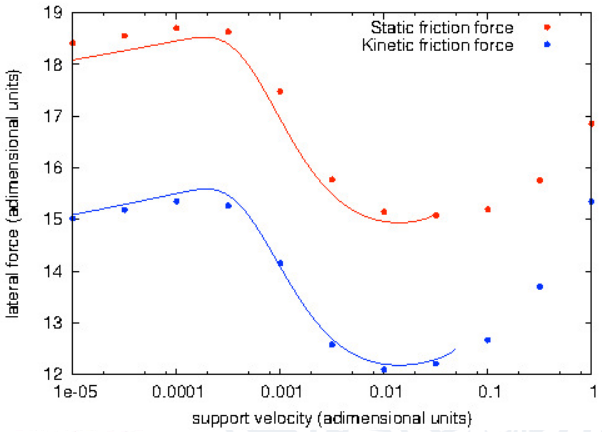
Ageing effects in the framework of the Prandtl-Tomlinson model.

Ageing is a fundamental problem in friction that has been recently observed and experimentally studied at the atomic scale in AFM experiments, where an atomically sharp tip is elastically driven on a clean crystal surface. In such works, a dependence of the lateral force with the tip waiting time, along with atomic stick-slip motion, is reported.

In this stay we have combined the use of analytical approaches and numerical Langevin dynamics simulations to study how ageing can be taken in the framework of Prandtl-Tomlinson models. In its simple way ageing can be included in the model by assuming time dependent amplitude in the tip-substrate interaction term, V_0. Then we have developed a theory to include such time dependence in the standard description for the logarithm dependence observed in the friction force versus velocity curves at a given temperature. We finish with a new analytical expression for such curves in the case of interaction amplitude, which change slowly with time.

Figure shows our analytical predictions for the static (average maximum lateral force) and kinetic (average lateral force) friction force, red and blue lines respectively and compare with numerical simulations (solid points). It can be observed a high agreement at the specific studied parameter values. In this calculus we have used a particular choice of the time dependent amplitude $V_0(t)=V_{01}+V_{02}(1-e^{-t/T})$, during stick the interaction grows from V_{01} to $V_{01}+V_{02}$ with time scale given by T and reset back at V_{01} at slip.



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