

# Physical origin of friction relaxation after interrupted sliding

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One of the most generic friction laws is the so-called rate-and-state friction law [1]. It combines the time-evolution of the static friction coefficient and the sliding-velocity-dependence of the dynamic friction coefficient. It is parametrized by two empirical parameters, which can be calibrated using macroscopic tests: the slide-hold-slide and the velocity step tests.

In the slide-hold-slide test, the friction coefficient decreases during hold (when the contact is left at rest after full sliding is interrupted). However, the physical origin of this relaxation remains unclear: is it due to bulk relaxation, interfacial slip-based relaxation or a combination of both? In this work, we address this fundamental question for dry elastomer/glass contacts. Our strategy is to monitor experimentally the displacement field at the contact interface when sliding is stopped, using digital image correlation techniques. This allows us to quantify the amount of slip occurring after the motion cessation.

We conducted experiments on an elastomer sphere in contact with a glass plane during interrupted shear tests at various fractions of the shearing distance required to obtain full-slip of the interface. The sphere is made, for optical purposes, of polydimethylsiloxane (PDMS), and has a curvature radius of  $R=9.42$  mm. To enable in operando evaluation of the shear displacement field thanks to digital image correlation (DIC) analysis [2], a thin subsurface layer of particles is embedded as close as possible to the PDMS sphere surface. The resulting displacement fields provide insights into the local behavior at the contact interface, particularly in identifying sticking and slipping zones [3] during post-shearing relaxation. We quantified the time-dependence evolution of the slip field, as a function of the normal force and of the shear distance before stopping, not only under standard frictional conditions, but also in fully stuck conditions by preventing any contact slipping during the shear.

Based on those results, we will discuss the combination of mechanisms involved in post-shear relaxation, shedding fundamental insights into the origin and contact history dependence of the static friction force.

## *References*

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