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Non-intrusive measurements of frictional forces between microspheres and flat surfaces WEI-HSUN LIN, Department of Physics, California Institute of Technology, CHIARA DARAIO, Department of Mechanical and Process Engineering, Swiss Federal Institute of Technology, DARAIO'S GROUP TEAM — We report a novel, optical pump-probe experimental setup to study micro-friction phenomena between micro-particles and a flat surface. We present a case study of stainless steel microspheres, of diameter near 250μm, in contact with different surfaces of variable roughness. In these experiments, the contact area between the particles and the substrates is only a few nanometers wide. To excite the particles, we deliver an impulse using a pulsed, high-power laser. The reaction force resulting from the surface ablation induced by the laser imparts a controlled initial velocity to the target particle. This initial velocity can be varied between 10^{-5} to 1 m/s. We investigate the vibrating and rolling motions of the micro-particles by detecting their velocity and displacement with a laser vibrometer and a high-speed microscope camera. We calculate the effective Hamaker constant from the vibrating motion of a particle, and study its relation to the substrate's surface roughness. We analyze the relation between rolling friction and the minimum momentum required to break surface bonding forces. This non-contact and non-intrusive technique could be employed to study a variety of contact and tribology problems at the microscale.

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