CICLO DE SEMINARIOS 2011

SMAT-C Soft Matter Research and Technology Center

"Drop impact of yield-stress fluids: rheology, splash and cratering"

Dra. Li-Hua LUU

Depto. de Física, Facultad Ciencias Físicas y Matemáticas, Universidad de Chile

I did my PhD in the IUSTI Laboratory in Marseille under the supervision of Y. Forterre. My thesis work concern experimental studies on the drop impact of yield-stress fluids. Beyond applications (solid ink-jet printing, lab modelling of high-speed collision of solids), this study offers a mean to probe the role of the elasticity on the short-time behaviour of these complex fluids. We have first studied drop impacts on solid rigid surfaces (Fig.1). Using different model yield-stress fluids (clay suspensions, Carbopol micro-gel) and impacted surfaces (partially wettable and super-hydrophobic), we have observed a rich variety of behaviours ranging from irreversible viscoplastic coating to giant elastic spreading and recoil. A minimal model of inertial spreading, including an

elasto/viscoplastic rheology, allows explaining in a single framework the different regimes and scaling laws. In this study, we identified a specific phenomenon with Carbopol: for large impact velocities, the drop spreads much more on rough hydrophobic surfaces than on smooth surfaces. This apparent reduction of the basal friction is discussed in terms of slip length and splash instability. Endly, we investigated the impact of a drop onto a pool of the same fluid, using a transparent yield-stress fluid (Carbopol). The combination of scaling laws, micro-gravity experiments and local deformation measurements by putting a network of particles in the bulk (Fig.2), shows that the transient crater is dominated by elasticity, even beyond the flow threshold. These results could have implications for impact cratering in Planetary Sciences.

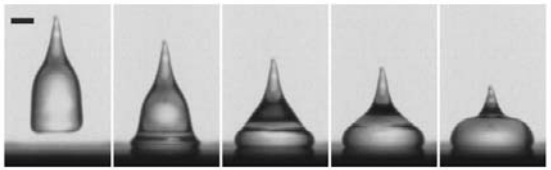

Fig.1. Typical drop impact on a glass surface with Carbopol 1 wt% at V_0=0.5 m.s^{-1}. Scale bar, 5 mm.

Fig.2. Typical particle tracking result: transient impact crater formation with Carbopol 0.5 wt% at V_0=5 m.s^{-1}. Color scale, green to red for increasing local deformation value.

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Sala de Conferencias, Tercer Piso, Departamento de Física
Universidad de Santiago de Chile

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