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Key role of the liquid-surface interactions to reveal hidden elastic properties in liquids

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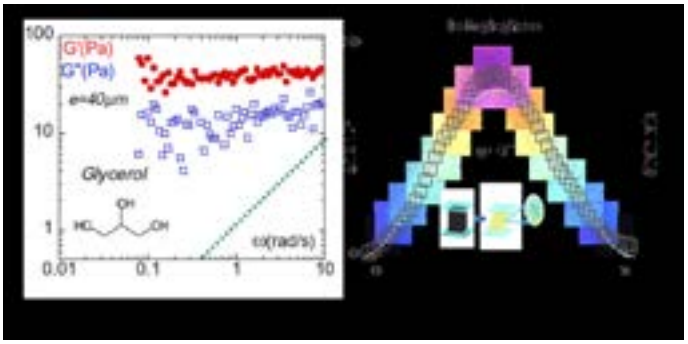
At the liquid-solid interface, the energy of the liquid is different from the bulk due to the imbalance between the attraction forces between molecules (cohesion) and the interactions of the molecules to the surface (wetting). In case of ceramic composites, liquid molecules are so strongly attracted to the high energy surface that the surface procures a total wetting. Because the viscosity measures the energy necessary to transfer a motion from a surface to the liquid, the force of the interactions to the substrate plays a key role in the determination of the fluid properties. By improving the liquid/surface boundary forces, high energy surfaces optimize the motion transfer during the rheological measurement. Low frequency shear elasticity becomes measurable bringing robust evidence that liquid molecules are not dynamically free but elastically correlated. The elastic property is experimentally identified on polymer melts, glass formers, Van der Waals liquids or liquid water pointing out a generic property. It sheds a new light on the mechanisms that govern liquid transport, gelation or glass processes or active materials and allows the identification of new effects as the conversion of a liquid phase in a strain-driven optical harmonic oscillator or the production of cold under flow that become possible when the liquid molecules are strongly anchored on high energy substrates.



a) By improving liquid/substrate boundaries, glycerol reveals a solid-like response at the mesoscopic scale (measured at room temperature, 40µm thickness).

b) New effects as the conversion of a liquid phase in an opto-mechanical oscillator are revealed and visualize the elastic response (thickness 200µm).

Biography

Dr. Laurence Noirez is CNRS Research Director at the Laboratoire Léon Brillouin (LLB), Université Paris-Saclay (France). She is working in a large facility that welcomes around 500 experimentalists per year; Dr. Noirez has a 25 years expertise in neutron scattering, diffraction and instrumentation. Her main developments concern a multiscale structural and dynamic study of simple and complex fluids (microfluidics) taking into account in particular the liquid/surface boundary conditions. Dr. L. Noirez established that liquids are long range elastically correlated and measured their low frequency shear elasticity. She also evidenced the impact of the interfacial forces on the liquid flow showing in particular that liquids can produce cold. She has published over SCI 130 articles.

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