Investigation of mechanical behavior of confined liquids at GHz-THz frequencies

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The manipulation of fluids at the nanoscale has become a major international field. This research area is attracting a lot of interest particularly due to the rapid development of nanotechnology and nanofluidics. In particular, the mechanical dynamics and thermodynamics of confined fluids at the nanoscale represent a controversially debated topic. For instance, understanding the properties of glass forming liquids is extremely important for many different research directions (fluidics, biotechnology, optoelectronics...). The respective contributions of finite size effects, surface effects and low dimensionality to the structure and dynamics in confined liquids represent just a few topical problems awaiting to be clarified.

The foremost field of expertise of our team concerns the study of generation and propagation of ultrashort transversally polarized (shear) acoustic pulses in liquids. Recently, we have been able to observe and characterize the transverse waves crossing a thin bulk-like layer of liquid glycerol [1-2]. At the moment, our experimental approach combining picosecond laser ultrasonics and ultrafast optics with femtosecond pulse trains represents a unique tool to study the viscoelastic properties of liquids at ultrahigh (0.1 – 1 THz) frequency range. A challenging idea to reduce the thickness of the liquid down to a few monolayers and to study confinement effects at ultrahigh vibration frequencies may reveal the fundamental mechanical and structural properties of liquids and their dynamics at the nano-scale.

The proposed research will therefore focus on:

1 - The implementation of femtosecond optical methods for the efficient generation and detection of GHz-THz acoustic shear waves.

2 - Experimental determination of viscoelastic parameters of nanoscaled liquid samples confined in different geometries.

3 - Finally, the interpretation of the experimental results based on Monte Carlo simulations and molecular dynamics.

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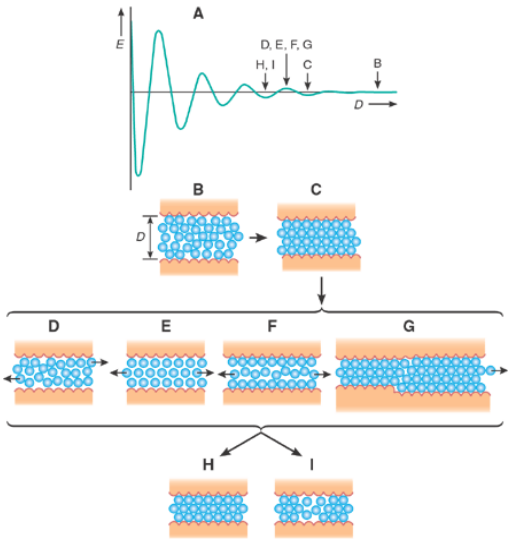
[1] C.Klieber. Photo-acoustic spectroscopy of supercooled liquids, PhD, Massachusetts Institute of Technology, 2010.
[2] T.Pezeril, C.Klieber, S.Andrieu, K.A. Nelson, *Phys. Rev. Lett.*, 2009, **102**, p. 107402



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