Determination of structural phase transition and visco-elastic length scales of 8CB liquid crystals through time-domain Brillouin scattering

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Background, Motivation and Objective

Your text explaining what has been done previously and why this work is of importance.

Liquid crystalline materials exhibit a rich variety of polymorphism, unique types of phase transitions and distinctive thermal properties which make them valuable for many applications. Their bulk or confined (i.e. in nano-sized pores) properties have been studied extensively through X-ray, light scattering, dielectric and calorimetric spectroscopy. There is little information available relating visco-elastic properties of various structural phases of liquid crystals to confinement parameters and respective length scales beyond tens of nanometers because of the “pore approach” necessary for the spectroscopic techniques listed above.

Statement of Contribution/Methods

Description of equipment, methods used.

We developed an experimental approach which allows studying the structural states of liquids and liquid crystals under continuously variable confinement condition from nanometers to bulk. We have adapted the experimental technique of ultrafast time-domain Brillouin scattering (TDBS) to investigate high-frequency longitudinal acoustic properties of the studied material. Our experiments yield direct access to the longitudinal speed of sound and the acoustic attenuation coefficient of liquids at GHz frequencies. The developed technique of TDBS offers substantial advantages since the frequencies are much higher compared with frequencies available by other techniques.

Results/Discussion

Presentation of the results obtained and discussion of the results.

We examined the structural changes of the liquid crystal 8CB across its isotropic, mesomorphic and crystalline phases at various temperatures. Since TDBS signals vary with temperature notably when their modification is linked to a structural phase transition, we were able to extract the mechanical properties of each individual phase. Furthermore, we studied the long-range molecular structuring of 8CB’s smectic phase at room temperature. Fourier analysis of the recorded TDBS signals for different liquid thicknesses yielded the value of the longitudinal speed of sound and the corresponding acoustic attenuation at GHz frequencies which highlight liquid structuring at long distances (i.e. larger than 30 nm) at the vicinity of the solid interface. Our results evidence the usefulness of TDBS to locally investigate structural transitions in bulk or conned liquids.