NON-LINEAR OPTICS TO PROBE THE STRUCTURE AND PROPERTIES OF ULTRA-CONFINED LIQUIDS

LABORATORY : Institut Lumière Matière

LEVEL : M1 / M2
TEAM(S) : LIQ@INT

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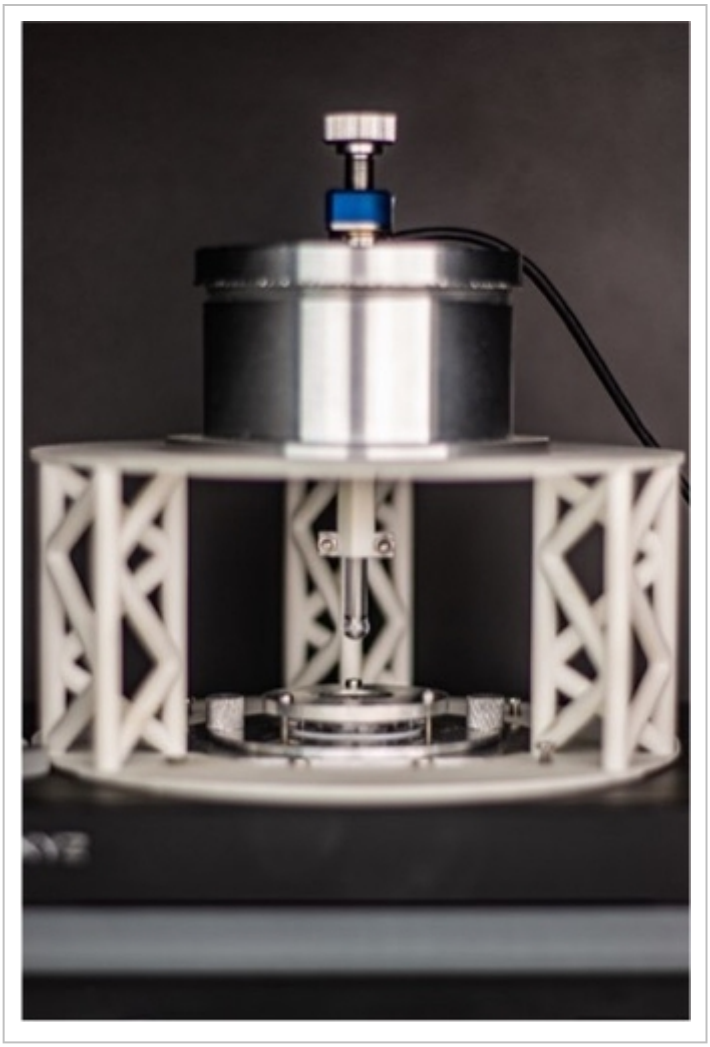
KEYWORD(S) : liquids / non-linear optics / confinement

SCIENTIFIC CONTEXT :

Knowledge of the properties of a liquid close to an interface is crucial for applications ranging from tribology and molecular biology to the flow of liquids confined in nanofluidic devices. Fluid flow on a nanometric scale has attracted a great deal of interest in recent years and some questions are still open. In particular, it has been shown that ultra-confined water exhibits change in viscosity of up to 7 orders of magnitude, while other studies show no measurable change in viscosity compared with volume viscosity. Moreover, when the distance between two surfaces is reduced to a few nanometers, the liquid is in fact ejected in layers, tending to demonstrate the existence of extreme molecular structuring when confinement is high.



To obtain information on the organization of confined liquid at the molecular scale, we have recently developed a microscopic tool using second harmonic generation (SHG). This nonlinear process, in which two photons at the fundamental frequency are converted in a photon at the harmonic frequency, is particularly sensitive to the symmetry. In a disordered liquid medium such as a free liquid, the SHG process is incoherent and therefore very weak. On the other hand, as soon as the molecules in the liquid show correlation in orientation over a time of the order of the pulse duration of the excitation laser (here 100 fs for the femtosecond laser available in our laboratory), this process becomes coherent and then shows a violent gain in intensity.

MISSIONS :

The experimental setup has recently been developed and in order to achieve the objective of ultra-confinement of liquids, it will be necessary to carry out preliminary studies. The intern will take part in these preliminary stages:

1) Study the non-linear response of a solution containing fluorescent molecules for which a high SHG intensity is expected.

2) Study the confinement of ionic liquids or electrolytic solutions.

OUTLOOKS :

The project may be continued as a thesis if a doctoral school grant is obtained.

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