Liquid friction acting on solid surfaces probed by second harmonic generation spectroscopy

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This work aims to investigate the friction acting on a solid surface and resulting from a fluid motion against it. Indeed, although the no-slip condition is known to be violated at micrometric scale in many systems, the liquid slip phenomenon occurring at the very surface is still far to be fully understood [1].

To better understand how fluids may behave very close to solid surfaces in a non confined environment, we used dye molecules physisorbed at the interface as local sensors. We chose second harmonic generation (SHG) spectroscopy to obtain orientational informations on the molecular system. SHG is indeed very well suited to probe buried interfacial regions thanks to its high sensitivity to non-centrosymmetric environments [2,3]. Moreover, it allows retrieving accurate information on molecular conformations through a polarized study [4].

In detail, we worked at the quartz-water (or water-glycerol mixture) interface. The SHG spectroscopy is executed in the total internal reflection configuration (see Figure 1). First, we performed a characterization of the dye orientation in static condition, that is with no liquid flow. Thereafter, the liquid flow is switched on and important SHG signal modifications are observed, those latter being attributed to dye re-orientation. By using different fluid viscosities and debits, we retrieved the correlation between shear rate and surface stress.

References

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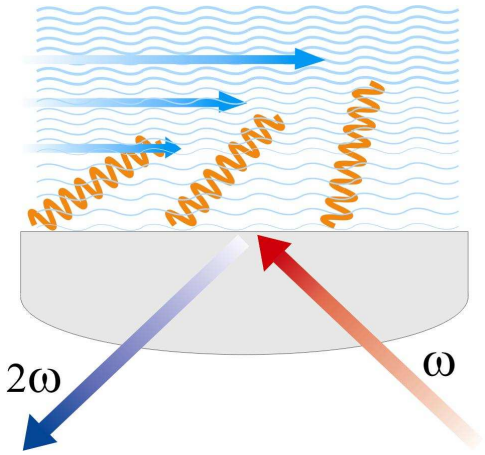

Figure 1. Second harmonic generation spectroscopy is used to probe how a solid surface responds to a liquid flowing over it. This is achieved through the analysis of the molecular re-orientation induced at the interface.