New fiber-optics platform for high-speed tracking of diffusion processes in fluids

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Tracking the motion of single nanoparticles is a gateway to understanding physical, chemical, and biological processes at the nanoscale. For example, by rapidly monitoring the charge (or the electrophoretic mobility) of a single solute, one will be able to study kinetic interactions such as ionization, hydrolysis, or charge transfer at the single particle level. In such an experiment, one can directly visualize the intermediate steps of a reaction, which is often untraceable in bulk experiments due to the sheer magnitude of the Avogadro's number.

I present a new experimental platform that enables tracking of free, unlabeled nanoparticles and macromolecules over a wide range of time-scales, from microseconds to hours. The key element of this technique is a single-mode opto-fluidic fiber, in which the high-index core contains an open nanometric channel that runs along the entire fiber axis. I report experimental detection of faint scattering and fast thermal diffusion of single dielectric particles as small as 10 nm and single unlabeled viruses with a mere scattering cross-section of 0.1 square-angstrom at a frame rate of more than 2 kHz.

By combining particle tracking with capillary electrophoresis it will become possible to study the charging dynamic of proteins at a single-particle level in biologically relevant environments.

Reference

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2- Sanli Faez, “How to replace the oil droplet in Millikan's experiment with a single virus”, arXiv:1601.01226