Study of mobility of fluorescent probes in viscoelastic media

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Mobility of molecules inside a viscoelastic system, such as a gel, is usually affected by the elasticity exhibited by such a system at higher length-scales[1], as well as by the size of the probes, the charge residing in the probes and the degree of crosslinking present in the gel. However, what is yet unknown is the point of crossover at this length-scale from purely viscous nature to a purely elastic one in such systems[2]. In our studies, we intend to understand how this viscous flow transitions to a motion under the influence of the elastic field, as well the degree of elasticity existing in such a system at both the nanoscale as well as the macroscale, usually quantified by the Young's modulus of elasticity of the system.

For this purpose, we use PDMS-Hexane as the viscoelastic system, and study the motion and behaviour of suitable fluorescent probes (dyes, proteins, etc.) of a great variety of sizes inside such a system. A Fluorescence Correlation Spectroscopy (FCS) setup, utilizing confocal microscopy principles, is employed for the purpose of such a study. In FCS, the fluctuation of fluorescent signal inside the confocal is recorded and an autocorrelation curve is obtained. By fitting the autocorrelation curve with proper

model, the diffusion time and the diffusion coefficients of the suitable probes can be calculated inside the viscoelastic media. In addition, a refractometer, a rheometer and a chromatogram utilizing Taylor Dispersion analysing principles have been used until now for extracting supporting information. This has enabled us to perform proper calibration of the confocal microscope for single particle analysis at nanomolar-scales suited to the individual fluorescent probes of different sizes, as well as to successfully determine the diffusion coefficients of these probes in the viscoelastic media[3]. In future, we intend to investigate the diffusion of other larger nanoparticles, the effect of the probe motion on the elastic nature of the viscoelastic gels of PDMS, as well as use AFM techniques to understand the elastic variations of such systems.

References:

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