Viscosity of a Crowding Medium Obtained through Optical Trapping

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The dynamic viscoelasticity a cellular medium is mainly due to the crowding of a large number of interacting and non-interacting proteins. Our research presents how the viscosity of a medium is altered in the presence of globular proteins. Optical trapping is the experimental technique that we used. Optical trapping is a process of using a laser directed through several lenses and focused into our sample which is filled with beads. When the laser interacts with a bead it uses the momentum of light to create the equivalent of a potential well which holds the bead within a small area allowing us to study the effects, much like that of a spring. Using the variance of the bead's position found using a Position Sensing Diode, we can find the stiffness of this 'spring' that holds the bead within the laser by using the Equipartition Theory. This stiffness leads us to the viscosity which we verify using a second method known as the Passive power-spectrum technique. This technique uses a Fourier transformation of the position data to convert to a power spectrum, fitting this with the Lorentzian and finding the corner frequency will give us the stiffness of the trap, which we compare against the previous method to confirm our findings. We used a 980 nm infrared laser and Nikon inverted microscope to develop a synthetic approach to calculate the viscosity of a medium. This approach has enabled us to calculate the viscosity of several water and glycerol concentrations. The method has been extended to investigate the viscoelasticity of the medium with various concentrations of globular Polyethylene glycol proteins.