# Measuring viscosities by optical tweezers

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We propose a new method of measuring viscosities of unknown liquids by optical tweezers. We built a system combing the optical microscope with optical tweezers. Fig. 1 shows the optical setup we have developed. The NIR laser with wavelength 1064 nm is used for trapping. The manipulation of a beam with trapped particle is provided by a galvano mirror which is controlled by the function generator. The trap is formed by tightly focusing the laser beam with the objective lens of 1.4 numerical aperture. If the amount of liquid is really small (10-100μL) and it's quite expensive or if the access to it is difficult, we can provide the measurements by optical tweezers. Also it can be applied for measuring viscocities inside of biological cells.

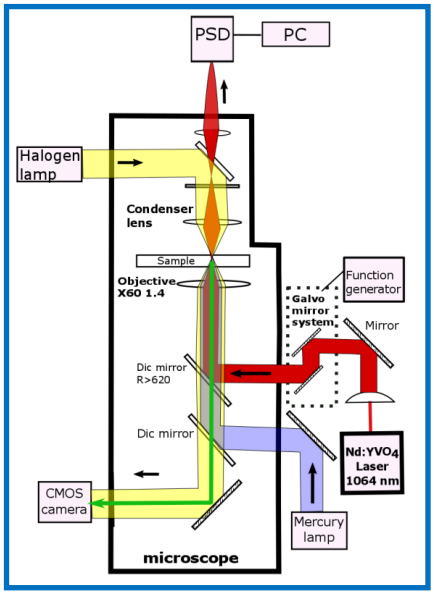


**Fig.1 Optical setup**

We used different mixtures of glycerin and water, like 10%, 20%, 30%, 40%. Polymer spheres sized 1um were chosen for trapping and manipulation in these liquids. The polymer sphere was stopped when it was trapped and moved by galvano mirror. We moved 1 um trapped polymer particles with fixed amplitude with different frequencies. Fig. 2 shows how amplitude of movement of the particle is decreasing with increasing frequency of movement. The trajectory of motion was detected by camera and analyzed by special spot tracker software. As a result, if we move a polymer particle in the liquid with of unknown viscosity, we can estimate the viscosity by measuring amplitude of motion at decided frequencies (in our case at 12 Hz). Fig. 3 shows viscosity of liquid if we measure the amplitude of motion of polymer sphere at 12 Hz. As a next step, we will measure the viscosity inside of biological cells. In this case, we will feed the cell with fluorescent particles.

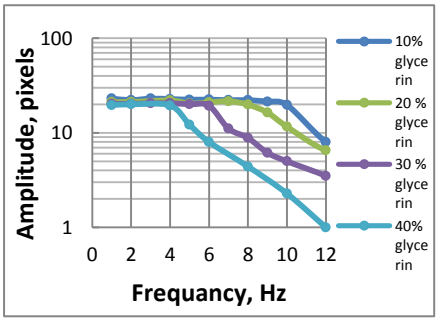


**Fig.2**

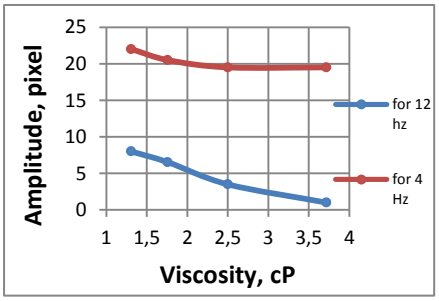


**Fig.3**