The purpose of this dissertation is to propose a new equation describing the viscosity of the concentrated complex liquids. Complex liquids such as solutions of polymers or surfactants are characterized by viscosities orders of magnitude larger compared to the viscosity solvent. This is due to the presence of mutually overlapped polymer chains or molecular aggregates (micelles). Despite the high viscosity values, diffusion coefficients of proteins and small molecules can be significantly higher than would be calculated from the Stokes-Sutherland-Einstein equation \( D = \frac{kT}{6\pi \eta_m r_p} \) where \( \eta_m \) is the macroscopic viscosity of the solution, and \( r_p \) is hydrodynamic radius of the probe. Assuming that the above equation is correct, the only explanation for such observation may be the fact that the viscosity coefficient \( \eta \) is a function of the size of the probe.

The measurements described in the dissertation were performed for aqueous solutions of polymer. The viscosity of solutions was calculated from measurements of self diffusion of particles in the examined solutions. It can be assumed that the viscosity determined in this way corresponds to the viscosity “felt” by the probe. In studies fluorescence correlation spectroscopy technique (FCS) has been applied. Measurements were carried out using polyethylene glycol solutions and fluorescently labeled proteins. Additionally, analysis of experimental data available in the literature for other systems such as micellar surfactant solution \( \text{C}_{12}\text{E}_6 \) and polystyrene solution was performed. This allowed to propose an equation describing the viscosity as a function of the size of the probe. This equation further applied to the analysis of the viscosity the cytoplasm of living cells (mammalian HeLa and Swiss 3T3 cells, and bacteria \( \text{E. coli} \)), as well as the viscosity of the colloidal solution of hard spheres.