

Project 3.3 Diffusion of rods and flexible polymers in complex fluids - theory and simulations

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Background:

Observation of the motion of a body gives information about the moving body itself and its environment as well. The above general rule also applies to the motion of a minute (much smaller than a hair thickness) particle in water. Suppose that such a particle is a protein, which is still much larger than a water molecule. The protein constantly collides with surrounding water molecules. The amount of collisions per second is enormous. They cause unpredictable in practice and complicated motion of the protein, called diffusion. Albert Einstein and Marian Smoluchowski introduced the theory of diffusion.

However, for about 70 years, there has been another question that bothers scientists. In many biological fluids, there are plenty of proteins or larger macromolecules, instead of a single diffusing particle. Is it possible to describe diffusion in such a complex fluid like in Einstein approach? Can the diffusivity be related to simple properties of the complex liquid, without referring to its specific structure?

Aim:

The goal of the project is to show in practice - by the joint theoretical and experimental study - how to describe diffusion in complex liquids. We will focus on the diffusion of DNA fragments and flexible polymers in complex fluids. As a result, the project should deliver a tool for interpretation of experiments in such industrial fluids as polymer solutions and in biological liquids, e.g. cell cytoplasm. It will thus help to design complex liquids and identify biological mechanisms important for life processes.

The project will be performed in collaboration with John F. Brady from California Institute of Technology and Stewart A. Mallory from Pennsylvania State University in the United States.

Requirements:

- education: Master degree of Natural Sciences (e.g. physics, chemistry, biotechnology, biology, biophysics), medicine or related discipline obtained before starting work in the project,
- good knowledge of English,
- CV and cover letter,
- letter of recommendation issued by an independent researcher,
- strong motivation and commitment.

In case of questions do not hesitate to contact me: Karol Makuch, email: kmakuch@ichf.edu.pl