## Description for the general public

Biological membranes function as a protection barrier from external environment making possible the maintenance of interior parameters crucial for functioning of cell (homeostasis). While composition of biological membranes is thoroughly studied, the molecular foundation of shape transformation in repose to changes in external environment and alteration of membrane composition are not well understood. It is believed that those phenomena depend on membrane composition and both electrostatic and mechanical properties. Since membrane is complex supramolecular structure its experimental simplification is required. The accepted experimental model of biological membrane is a lipid bilayer in the form of quasi-spherical vesicles consisting of lipid bilayers (liposomes). The main objectives of the project are the development and implementation of experimental methods suitable for the determination of a lipid bilayer mechanical properties. Mechanical properties are critical for cell functioning, because they influence broad range of processes such as mechano-sensing, cytoplasm volume control or tissue formation. For example, it has been observed that the proper blood vessel formation require the well-defined environment from the mechanical point of view – in other situation the formation did not occur. The mechanical properties of liposomes can be dissected into three components; bending deformations, which are responsible for shape and spontaneous fluctuations of a membrane, the dilation caused by the lateral external pressure, and shear stress, which is understood as a friction within the bilayer due to changes in the orientation of lipid molecules in the response to temperature change or linear tension between domains (rafts) formed in complex membranes. By using the technique based on the analysis of spontaneous fluctuation it is possible to determine the membrane parameter describing the bending deformation, whereas optical tweezers can be used to deform the membrane by pressing the polystyrene bead onto the lipid bilayer surface what will allow to determine the parameters describing the extend of membrane dilation. The assessment of shear stress will be made by evaluation of mechanical properties of the membrane composed of distinctly different domains. Experimental results will be interpreted with the help of molecular dynamic simulations. In these simulations each atom of the lipid bilayer is represented as a sphere, which satisfy Newton dynamics. This approach allows the investigation of the evolution of such system in time. The understanding of the correlation between molecular level process and mechanical properties of the membrane has not been described before. It will be used in the subsequent investigations of the effect of externally added membrane modifying agents such as proteins and amphiphilic molecules on the mechanical state of the membrane. It is believed that there is a connection between the aggregation states of membrane associated proteins and membrane mechanical properties, which may lead to neurodegenerative disorders.