The influence of selected nanoparticles on the elastic properties of endothelial cells evaluated using atomic force microscopy

Description for the general public

Over the last few decades there has been an increase in interest and use in medical devices of various types of nanomaterials. Nanostructures are increasingly being used as intermediates during drug transport. But whether the impact of nanostructures on cells has been thoroughly investigated? The proposed project deals with the understanding of **physicochemical mechanisms** related to the interaction of nanostructures (such as dendrimers, carbon nanotubes and silver nanoparticles) on biochemical processes that may lead to their **mechanical properties at nanometer scale**. The main method of this project is **atomic force spectroscopy**, which allows to study mechanical properties of cells. The changes in cell mechanics take place in nanoscale, so it is necessary to use nanotechnology methods to study them, which is an innovative aspect of the proposed research.

The **biological system** used for testing of selected nanostructures in the context of elastic properties measurements are endothelial cells. The endothelium constitutes a barrier which separates the blood from the tissues which are located deeper, thus it is a first contact line for drugs and nanostructures.

The endothelium due to the location *in vivo* is subjected to continuous narrowing (vasoconstriction) and widening (vasodilation), therefore elasticity of these cells plays an important role in understanding the physiological intracellular processes. On the other hand, a correlation between endothelium elasticity and the level of secreted nitric oxide, which is responsible for vasodilation and inhibition of platelets aggregation can be found in many literature reports. The elasticity of the cells can be treated as an *in vitro* marker of physiological conditions of the endothelium. **The scientific goal of the project is to describe changes in elastic properties and morphology of endothelial cells treated with various types of nanostructures.**

Characterization of selected nanostructures will be carried out using modern microscopic and spectroscopic methods including atomic force microscopy (AFM), scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS) analysis, transmission electron microscopy (TEM) and dynamic light scattering (DLS) technique.

Measurements of the viability of endothelial cells treated with selected nanostructures will be performed with a spectrophotometric method using tetrazolium salt reduction tests (XTT). The study of cells elasticity will be performed by atomic force spectroscopy and will be complemented by microscopic observations of fluorescent staining of the cytoskeleton and cellular nuclei and also spectrophotometric determination of nitric oxide levels. In order to examine the location of the nanostructures (within the cell or onto the cellular membrane) it is planned to conduct experiments using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The results achieved in implementing of the planned project should also contribute to the progress in the field of **physical chemistry of biological systems and biophysics.**