Abstract

Nanomaterials entered the biomedicine already at the beginning of the millennium and they still bring new and unique advances and possibilities for treatment, diagnosis and regeneration, thus they continue to facilitate the development of personalized medicine. Interactions at nanoscale allow until then unconceivable opportunities to influence processes on molecular level. The completely new perspectives of nanomaterial applications jointly raise attention concerning health and environmental safety issues. Although a lot of novel biomedical applications of nanomaterials have emerged, the vast majority is still found to be at the stage of a concept. The consistent basic *in vitro* research of elemental interactions of nanomaterial with biological environment should represent an essential part of its development.

The concern of this thesis was to describe the cytocompatibility and interactions of two types of nanomaterials with different human cells. First, ultra-fine grain titanium was tested for prospective use in implant development. We confirmed its positive effect mainly on the growth of osteoblasts and recommended the further pre-clinical trials of this material in a form of a bone or dental implant. Second, several types of ultra-small (< 5 nm) nanoparticles of different origin (silicon, gold and platinum) were described in various conditions to obtain information about their time- and concentration-dependent cytotoxic potential and behavior in cell culture. The formation of protein layer on nanoparticle surface, which naturally occurs in biological fluids, proved to be a crucial parameter for interactions with various cell types. For subsequent research, a series of modifications of mentioned nanoparticles were proposed in order to improve their performance in living organism.

This thesis elucidates the importance of basic *in vitro* evaluation of nanomaterials and emphasizes the need of interdisciplinary cooperation in this complex topic of integration nanotechnology into biomedicine.