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Summary of the thesis entitled *"Establishing the origin of mechanical and biophysical properties in pure titanium processed by an unconventional severe plastic deformation"*

The main purpose of the dissertation was to explicitly point out the sources responsible for the increased strength and biophysical properties in commercially pure titanium subjected to the multistage Hydrostatic Extrusion (HE) process. In addition, an in-depth microstructural examination was realized in order to trace the microstructure evolution of titanium during HE. Mechanical behavior of the material was assessed in a series of static tensile and compression tests as well as fatigue tests, while characterization of biophysical properties was carried out with the help of Atomic Force Microscopy (AFM) and X-ray Photoelectron Spectroscopy (XPS) techniques as well as wettability determination, cytotoxicity measurements, protein assays and Confocal Laser Scanning Microscopy (CLSM).

An abundance of differently sized grains of various shapes and microstructural defects proves that titanium obtained by the multistep process of HE is a highly heterogeneous material with regard to its microstructure. Moreover, the claim is supported by tremendous misorientation gradients in randomly chosen grains and the large deformation energy stored. At low strains, the main grain fragmentation mechanism dictating the microstructure downsizing is the grain subdivision process. At intermediate and high strains, the process of continuous dynamic recrystallization comes to the fore. The development of a significant substructure and the presence of high-angle grain boundaries are responsible for the increased strength of the hydrostatically extruded titanium. Due to the process of HE, tensile strength of a material gets increased nearly two times when compared to the unprocessed, coarse-grained titanium.

With respect to biophysical properties of the HE-treated titanium, it could be stated that, regardless of the cell line or protein analyzed, it is the abundance of deformation-induced surface defects and the presence of prismatic planes exposed to the surface, not necessarily the small grain size, that mediates cell-material relationship. In addition, the role of surface

roughness, wettability as well as chemical composition has shown to have a minor influence on biological behavior of a material. Due to the fact that osteoblasts grew and thrived more vividly on the surface of hydrostatically extruded titanium than endothelial cells, it might be concluded that the material may be an appropriate candidate for dental or orthopedic applications.

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