

The aim of the project is to develop new materials composed of very small grains, called nanomaterials (in the form of alloys and composites) based on tantalum. Developed new materials will be used in highly aggressive environments, causing the rapid progress of corrosion as well as working at an elevated temperature. These materials find potential applications in implants as biomaterials, too.

New nanocrystalline alloys and composites will be developed and their surface will be improved. The materials should have properties respective for working in heavy conditions. The manufacturing process and materials properties will be studied.

It is predicted that new developed nanocrystalline materials will have better mechanical and physicochemical properties and show a better stability in harsh environments than their conventional counterparts (having larger grains).

New nanocrystalline alloys and composites will be made using pure metal and ceramic powders subjected to the process of the mechanical alloying (MA).

As a result of intensive mixing, grinding and cold sintering during mechanical alloying, the powders will transform into respective alloy or composite, showing required chemical composition and properties. These powders will be then hot pressed by a pulse plasma sintering method (PPS) to consolidate to the high density and strength and to limit grain growth. As the final effect of the process will be sintered semi-product. For comparison, beside PPS sintering the induction heating/sintering will be applied during some powders sintering.

Furthermore the sinters will be subject to a surface treatment involving anodic oxidation, to produce an oxide layer of enhanced thickness, improving resistance to external environments.

The materials will be tested at each stage of experiment using methods for structure, microstructure and morphology characterization. Final sinters will be tested in terms of mechanical properties including properties in nanoscale, and corrosion resistance as well as resistance to high temperature.

Due to develop of the new materials, it will be possible to accelerate progress in the development and application of biomaterials, materials for applications in thermal power and corrosive environments. The new alloys and composites possessing nanostructure shall have a high mechanical and physicochemical properties compared to conventional large grain materials.