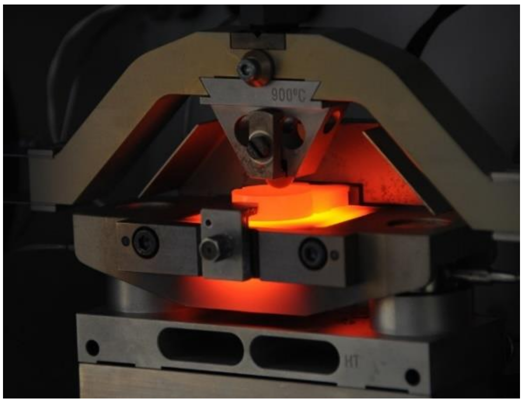
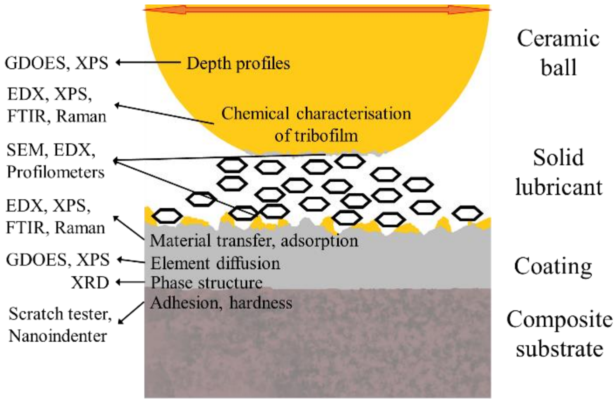
Investigation of wear mechanisms of titanium ceramic-metallic composites under solid lubrication in high-temperature oscillating contact conditions

Tribology is an interdisciplinary science and technology discipline, which includes friction, wear and lubrication research. **Tribology processes in mechanical systems working at high temperatures, reaching 1,000 °C, require special control, because high friction leads to extensive wear, energy losses, and even catastrophic failures.**



Mechanical components are usually made of steel, but their tribological properties and resistance to oxidation are limited at high temperatures. These properties can be improved, e.g. by means of material replacement or modification, modification of a production process, deposition of anti-wear coatings, or use of lubricants. In this research project, new potential materials that are considered to hold great promise for high-temperature tribological applications, i.e. TiB_2-Ti composites manufactured by means of spark plasma sintering (SPS), will be investigated. Researchers from leading research institutions proved that TiB_2-Ti composites have great wear resistance in sliding conditions at high temperature. However, in real-life tribo-couples oscillating motion is common. From the preliminary research conducted by the authors of the project is follows that TiB_2-Ti composites are responsive to oscillating friction, which limits their applicability. A new and innovative approach is necessary to make use of the advantages TiB_2-Ti composites offer.



The proposed work will apply thin protective coatings, deposited by means of vacuum methods (PVD), as anti-wear and anti-oxidise coatings, and a solid lubricant, applied as component of composite or external, at surface, to reduce the coefficient of friction.

Oscillating wear tests will be conducted using a high-temperature version of oscillating ball-on-disc SRV (Schwingung Reibung Verschleiβ) friction and wear tester.

To understand basic principles in the friction couple, extensive analyses of surfaces of specimens will be performed. The most precise profilometry methods and scanning electron microscopy (SEM) will be used. The comparison of chemical composition of fresh and tested specimen will be performed by chemical composition spectral analysis methods. The chemical composition of these coated/composite materials will be measured using Energy Dispersive X-Ray Spectroscopy (EDX). Fourier-Transform Infrared Spectroscopy (FTIR) will be applied to perform a chemical analysis of top layers of rubbing elements. Raman Spectroscopy will be used for molecular level studies of thin films physically absorbed on surface and surface oxidation products. Glow Discharge Optical Emission Spectrometry (GDOES) depth profiles will be acquired, and changes in elemental composition in depth will be analysed. X-Ray Diffraction (XRD) will allow the analysis of the crystalline state and structure of the surface material.

The work will contribute to the description and understanding of synergetic and antagonistic interactions between investigated materials (composite, coatings and solid lubricant), occurring under oscillating motion, at high temperature, and under extreme contact pressure.