

Description for general public

Complex Metallic Alloys (CMAs) are modern, multicomponent metallic materials, where in contrast with conventional metallic alloys, one unit cell of crystalline structure may contain up to thousands of atoms arranged in well-defined clusters. These materials, although discovered in the twenties of the twentieth century, are not well understood, especially in terms of ‘fabrication – microstructure – properties’ correlation. And their properties are exceptional, like low friction, high wear and corrosion resistance, hydrophobicity, high electrical resistance or resistance to high temperature corrosion, what opens the way for their application as coatings. Development of advanced low-temperature plasma surface engineering methods, like PVD, potentially allows to produce these type of complex materials in form of coatings. Nevertheless, this hypothesis needs to be verified.

The general goal of the project is to develop scientific basis for the magnetron sputtering (PVD) process to produce CMA coatings from the AlCrFe system. There will be determined: (1) what structure (phase composition and microstructure) is formed for different chemical composition and PVD process parameters, (2) what microstructure is optimal for best functional properties and (3) what is the range of properties possible to achieve. Moreover, an important aspect of the project will be to design such deposition process parameters to ensure high coating quality with good adhesion to the substrate and preservation of treated material’s properties. The scope of research includes investigations of coating’s phase composition and microstructure, its morphology and surface topography, residual stress state and adhesion to the substrates. Also, some of functional properties will be determined, like: hardness, wear resistance, corrosion resistance in several various environments (also at elevated temperatures), as well as their wettability and surface energy.

Research foreseen in the project is of great cognitive importance and will result in the development and optimization of technological conditions leading to production of high quality AlCrFe coatings on steel and titanium, elaboration of their characteristics and deposition mechanisms and determination of deposition process parameters’ influence on their functional properties. These coatings have a great potential to be a versatile solution in terms of material protection against aggressive corrosive environments both at room and elevated temperatures and with unique combination of properties.