Description for general public

Cold spraying is the state of art of thermal spraying, which found a number of unique applications in various industries. The main advantages of cold gas sprayed coatings is a high purity and excellent mechanical properties, unattainable previously used methods of spraying. The surrounding atmosphere and high temperature occurring in the case of plasma spraying resulted in a number of detrimental phenomena as oxidation, evaporation of material, phase changes, recrystallization, release gases, delamination, and deformation, which significantly reduced the coating properties. All these problems are eliminated in the case of cold spraying. During cold spraying powder particles are deposited as a result of severe plastic deformation at a temperature below the melting point of the metal at the moment of impact with the substrate. The particles of powder stick together on the base of adiabatic shear instability phenomena in the areas of the particle-substrate and particle-to-particle. The cold sprayed coatings are characterized by a phase identical to the coating material, negligible porosity, very high cohesion and adhesion to the substrate.

The scientific goal of the project is to determine the correlation between the degree of metastability of the structure and its grains refinement in nano scale on wear characteristics of the cold sprayed coating (Cr_3C_2-25(Ni20Cr))-(Ni graphite) followed by laser surface treatment. The phenomena occurring in surface layer (degree of metastability, a density of lattice defects, diffusion, plastic deformation, residual stresses), mechanical and tribological properties of the coatings will be investigated. The second scientific objective will be the analysis of the influence of substrate (Al 7075 alloy and stainless steel) on the coating adhesion to the substrate and the cohesion between particles forming layers under the conditions of dynamic plastic deformation. The morphology and structure of adiabatic shear bands generated in Ni20Cr alloy by dynamic deformation of the powder grains will have a major impact on the adhesion of the coating and its cohesion. The analysis of the microstructure in macro- and micro/nano scale will reveal its details both near the coating/substrate interface and between the coating forming particles.

The research strategy for cold sprayed coatings with surface laser treatment creates new possibilities of improving the properties and durability of elements coated with (Cr_3C_2-25(Ni20Cr))-(Ni graphite) coating, as low friction coefficient, high hardness and wear resistance with the possibility of working at elevated temperature. The cold sprayed and laser treated surface coating on Al 7075 alloys will improve their tribological properties while sprayed on stainless steel substrates will also allow them to be used at temperatures up to 500 ºC. Such cermet coating is drawn much attention because of its outstanding mechanical and tribological properties. It should also be emphasized that there is no data in the literature describing the creating of cermet (Cr_3C_2-25(Ni20Cr))-(Ni-graphite) coatings containing solid lubricant during cold spray process and subjected to laser surface modification as well as correlation of their microstructure features (morphology, cohesion, adhesion, phase composition, phase distribution, residual stresses, surface topography) with mechanical and tribological properties. The application objective of the project is to improve the operational properties of kinematic pairs in terms of lowering friction and increased durability at higher loads and increased temperatures.