Ceramics have unique properties, such as high hardness, wear resistance, high temperature chemical agents resistance, good dielectric and insulation properties, and thus is more and more often used in various industries. Ceramics is generally used to produce final parts. However, in some cases it is necessary to deposit ceramic coating on the metal substrate. This sort of coatings is used to change surface properties of metals, where active coatings can be distinguished. One of the most attractive oxides in this group of materials is titanium dioxide, and especially its two crystalline forms: anatase and rutile. This materials can be used in implants, gas sensors or solar panels. What is more, titania shows photocatalytic properties and can activate chemical reactions under the influence of light radiation. As a result of this reaction self-acting removal of various organic soils from surface of the element is possible. TiO_2 coatings with submicron grains are usually deposited with two-stages dip coating method. However, necessity of coating post-heating and problems with material uniform deposition cause serious problems and therefore new deposition methods are quested. One of the proposal is group of thermal spraying methods. In conventional thermal spraying, e.g. atmosphere plasma spraying (APS) or high velocity oxygen fuel spraying (HVOF) high temperature is present, what cause growth of powder grain size, phase transition of anatase to rutile, which have lower photocatalytic properties. As a result, deposited coatings shows limited efficiency in soil removal. On the other hand, among thermal spraying methods there is also cold spraying (CS), which can be applicable in titania deposition. Cold spraying is characterize by low spraying temperature and therefore process is conducted with powder material in solid state and thus primary material properties are maintained. This method is dedicated to metal powders, where bonding mechanism base on mechanical interlocking of the single particles and mixing of particle and the substrate materials as well. It arise from plastic deformation of powder and substrate materials. In the case of brittle materials, such as ceramics or glass, plastic deformation does not occur. Hence, after discovering the cold spraying in the ’80 of XX century scientists thought that direct deposition of ceramic coatings is impossible. According to the literature, last years showed positive trials of pure ceramic coatings deposition. Researchers tried to determine the bonding mechanism of this coatings to optimize spraying process. First trials showed possibility of ceramics deposition by plastic deformation of substrate material and powder particles mechanical interlocking. Further incoming particles deposit by binding to the flash of substrate material. This mechanism limits the thickness of the deposited coating. The lack of possibility to deposit fully ceramic coating was probably caused by a morphology of the powder used. However, suitable powder preparation of ceramic powder enables its stable deposition on the substrate. One of the examples is TiO_2 powder produced by $TiOSO_4$ hydrolysis reaction.

The main aim of the project is to determine bonding mechanism of ceramic coating deposited by cold spraying with the use of powders produced by sol-gel method. Detailed analysis will concern the influence of the morphology, rate of crystallization and polymorphous type of the powder material on the bonding mechanism. What is more, the influence of ceramic powder particles surface modification with the use of functional groups or metallic nanostructures will be analysed. It is planned within the project to produce powders of two materials: TiO_2 and SiO_2, which differs significantly in parameters, e.g. hardness. Powders will be produced with sol-gel method based on suitable organometallic precursors.

It is planned to conduct microscopic (SEM, EDX), diffraction (XRD) and Raman spectroscopy analysis. After optimization of powder materials coatings will be deposited by cold spraying method. The coatings structure will be analysed with the use of SEM microscopy, X-ray diffraction and Raman spectroscopy. Hardness and Young’s modulus will be measured using nanoindentation testing and bond strength with scratch test. Photocatalytic properties will be determined with the use of absorbance spectroscopy in the scope of visible light on selected organic dye. Additionally, resistance on electrochemical corrosion will be examined also.