The regeneration of the catalysts used in the oxidation reactions, eg. exhaust combustion, is a big problem. Applied catalysts become deactivated over time due to the aging processes that occur under operating conditions like high temperature.

The aim of the project is to study the self-regeneration of the catalysts based on nanocrystalline cerium oxide. Such ability occur for the cerium mixed oxides doped with precious metals. Under reducing conditions the formation of small (1-2nm) metal crystallites (eg. a palladium or rhodium) on the surface of ceria was observed. When the reaction conditions change to oxidizing, atoms of noble metal return to cerium oxide lattice. Thanks to this the structure and morphology of the catalyst after the reaction resembles that of the pre-reaction, whereby the catalyst lifespan is much longer. This phenomenon is very interesting both in terms of basic research and application.

The project will examine the process of self-regeneration mechanism. It was hypothesized that the introduction of a suitable amount of defects in cerium oxide lattice will facilitate the regeneration process. This approach is innovative. There will be basic research for determining the composition, structure and morphology of the new obtained catalyst, regeneration process and the catalytic activity using the research methods such as: X-ray diffraction (XRD), transmission electron microscopy (TEM), Raman spectroscopy, scanning electron microscopy with EDS analysis (SEM-EDS). As part of the grant principal investigator will leave at research trip for 3 months to one of the best microscope group in Germany. It is planned also studies with X-ray absorption spectroscopy (XAS) using synchrotron radiation, which gives a broad measurement capabilities. The most important methods used in the project will be in-situ TEM and in situ XAS. They give the possibility of carrying out measurements under conditions similar to those prevailing during the catalytic reaction, instead of high vacuum, as it usually takes place in the case of microscopic examination. As a result, changes in the structure and morphology of the catalyst will be investigated under real conditions.

This subject of the research because it is very interesting, and the results of the project will have a big impact on future research and application oh the oxide catalysts.