The so-called advanced oxidation processes (AOPs) constitute a family of similar but not identical technologies that are based on the generation of highly oxidative species, such as Reactive Oxygen Species (ROS, e.g. hydroxyl radicals or superoxide anions). One of the most intensively studied AOPs are photocatalytic oxidation (oxidation reaction with the use of light), Fenton and Fenton-like processes (oxidation reaction with the use of hydrogen peroxide), sulphate radical based processes (oxidation reactions with the use of persulfate/peroxymonosulfate) and ozonation (oxidation reaction with the use of ozone). The great advantages of all above mentioned AOPs are utilization of heterogeneous catalysts and environmentally friendly oxidants to generate highly oxidative species, high efficiency of these processes in oxidation of organic compounds, and the fact that the efficiency of these processes can be improved by the application of hybrid synergistic technologies based on the combination of various AOPs. For these reasons, AOPs are considered to be one of the most promising alternative to widely used oxidation reaction with the use of hazardous and toxic inorganic oxidants, such as permanganates or chlorine. Nevertheless, AOPs are not new technologies, it is important to stress that the fundamental knowledge on the factors affecting the ability of heterogeneous catalysts – **especially these containing gold** – to generate highly oxidative species, as well as the reactivity of these highly oxidative species in oxidation of organic compounds have not been well investigated.

The aim of the project is to synthesize, characterize and outline the use of new gold-based catalysts supported on niobium- and cerium-containing zeolites and bulk niobia and ceria in selected advanced oxidation processes (i.e. photocatalytic oxidation, Fenton-like process, sulphate radical based oxidation process, and **hybrid technologies** being combination of the above mentioned AOPs). Research planned include studies on the investigation of the factors affecting the catalysts ability to generate ROS, as well as the catalysts activity and selectivity in AOPs. The important part of the project is also the evaluation of the role of different reactive oxygen species in oxidation of organic compounds.

The project includes the synthesis of materials using well-known and efficient methods, as well as the detailed characterization of the catalysts using various advanced and complementary techniques that will allow to investigate the structure, texture, composition and properties of synthesized materials. The catalytic activity of materials will be evaluated in oxidation reaction performed in gas phase (photocatalytic oxidation of methanol) and liquid phase (oxidation of benzyl alcohol, phenol and model organic dyes – e.g. rhodamine B, methylene blue).

It is expected that the project will provide new insight on the generation of reactive oxygen species on the surface of heterogeneous catalysts, especially these containing gold species, and will allow determination the role of ROS in oxidation of organic compounds. The detailed studies on the hybrid advanced oxidation processes will allow to understand the role of different components of catalysts in the generation of reactive oxygen species, and thus it will provide the new tools to tune the catalysts composition and reaction methodology to improve the efficiency of environmentally friendly oxidation processes. It is also expected that the project, in long time perspective, would facilitate the elimination of hazardous inorganic oxidants and their substitution by “greener”, highly efficient, hybrid advanced oxidation processes.