Searching for novel catalysts for soot emission abatement from automotive exhaust gases - bimetallic Ru-Re and Ru-Pt nanoparticles supported on oxide carriers

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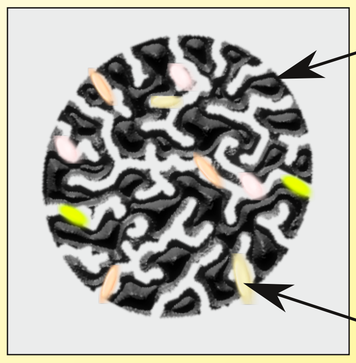
More and more rigorous regulations regarding the PMs emissions are the reason of the constant demand for the new, more efficient automotive catalysts. The results of the project will be significant for the creation of the new generation of the catalysts which could be less expensive alternative for currently used systems for this purpose. Moreover, in this project attention was paid not only to the catalytic combustion of carbonaceus soot, but also to the removal of the very toxic polyaromatic hydrocarbons from the cars exhaust.

Concentrations of PAHs and dust pollution in Poland are higher than in any other country of the European Union, and the most polluted big cities in the EU for years have been Krakow and Wroclaw. In February 2018, the EU Court of Justice convicted Poland of the violation of the EU regulations on clean air.

The catalytic systems proposed in this project are based on ruthenium nanoparticles as the main active phase. Ru is a very attractive alternative for currently used in industry catalysts based on platinum or palladium. Ru is much cheaper than these metals and more resistant to poisoning with sulfur, carbon monoxide and water vapor.

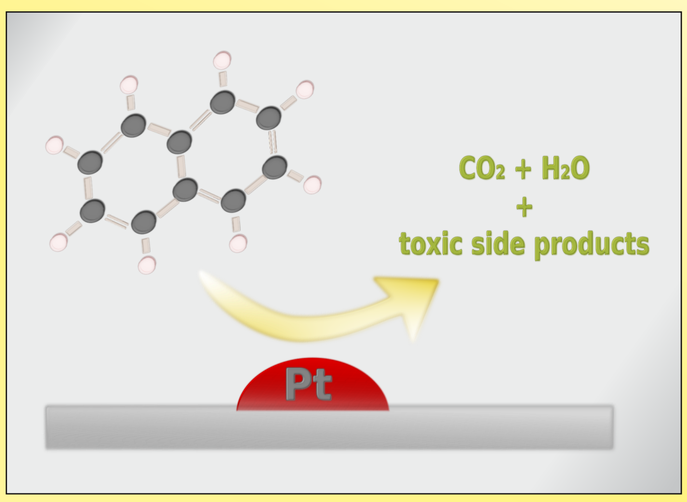
Particulate matter removal

Total combustion of soot

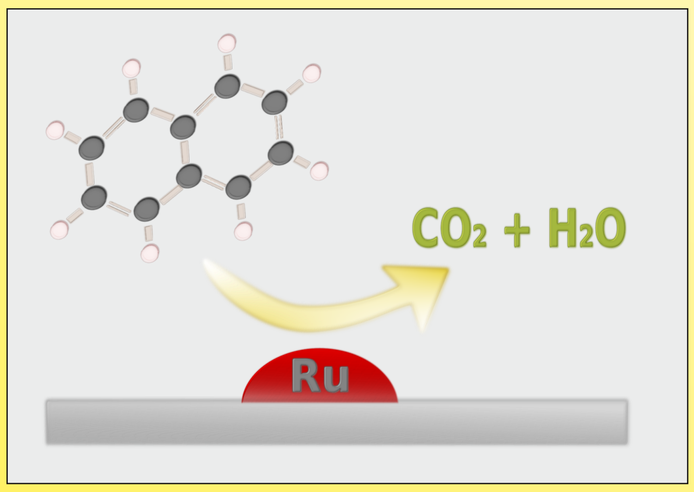


Total combustion of adsorbed hydrocarbons

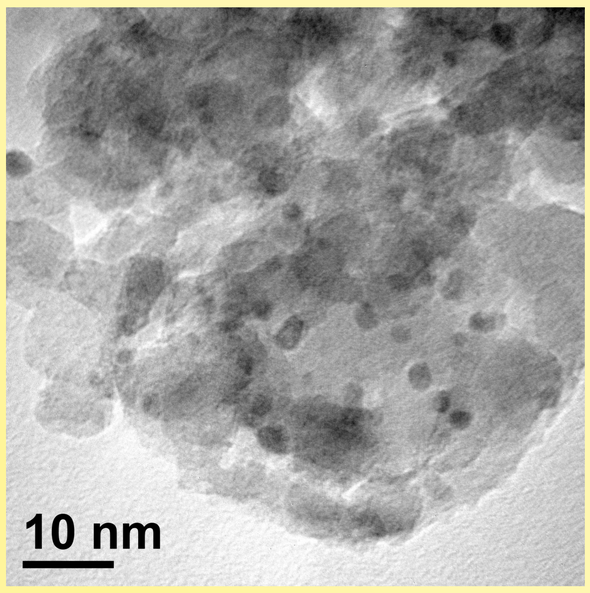
PAHs total combustion - very important issue



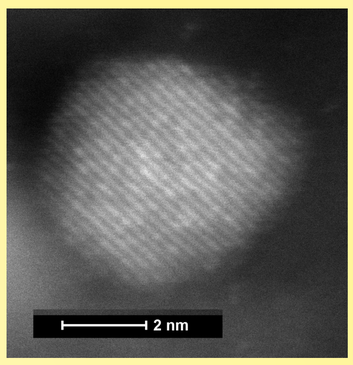
It must be considered that during the catalytic combustion of the naphthalene, side products, like polymerized polycyclic aromatic hydrocarbons, oxygenated aromatic compounds and benzene derivative compounds, usually more toxic than naphthalene, can be formed. The achieving a high selectivity to CO_2 is an important target.

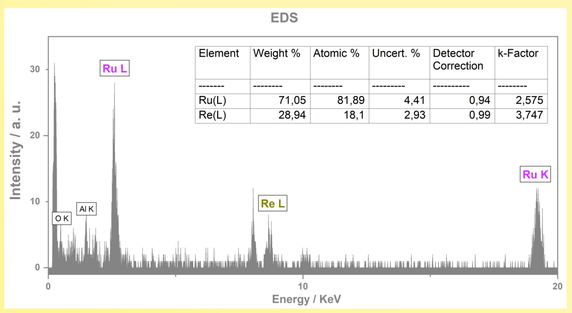


2%Ru-0.8%Re/γ-Al_2O_3



The solution to the problem of the low thermal stability of the ruthenium may be the introduction of a second metal into the system and the application of new techniques for the preparation of the metallic particles. The polyol reduction method is one of the most effective for this purpose. Low temperatures and short reduction times used during the colloidal techniques allow to limit the growth of the metallic phase grains.





Colloidal synthesis in ethylene glycol using a microwave reactor is an effective new method for obtaining RuRe bimetallic nanoparticles with the diameters of a few nanometers. The nanoparticles supported on Al_2O_3 are very stable and did not have tendency to the agglomeration.

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