

Application 2037



Catalytic combustion of hydrogen

Asunción Fernández

Consejo Superior de Investigaciones Científicas CSIC, Seville

There are various applications for heating with hydrogen, but mostly in a larger scale, starting from household device (general heating) to industrial uses. These applications are using mainly flame or hybrid combustions.

The catalytic combustion of hydrogen is very suitable avoiding flames and also specifically for smaller and mobile purposes with smaller hydrogen consumption under safe conditions. If hydrogen is implemented as an energy carrier on the large scale, the issue of safety has to be taken into account. Any exhaust gas of a hydrogen using device must be free of hydrogen. Catalytic combustion provides a cheap and safe way of removing H₂ from a gas stream.

Main topics to be investigated in this project using the Lasy infrastructure at Empa: i) Fundamental studies on the synthesis and microstructural characterization of catalysts and monoliths; ii) catalytic activity measurements for the combustion of lean H₂ fuel-air mixtures.

i) Fundamental studies on the synthesis and microstructural characterization of catalysts and monoliths

Commercial silicon carbide foams have been selected as the support to fabricate a monolithic structure in which the catalysts can be supported by wet chemical impregnation methods or by alternative new methodologies that could be investigated as sputtering deposition technologies methods. The selected catalysts will be based on Pt nanoparticles known as a good catalyst for the H₂ combustion reaction working even at room temperature with a very good activity.

As an alternative cheaper catalysts a CuO-Al₂O₃ material prepared by wet chemical methods will be tested.

The wet chemical co-precipitation methodology as well as the slurry impregnation methodologies are available at the laboratories in EMPA and will extensively used during the stay.

The sputtering methodology is available in Sevilla and will be complemented the work in EMPA. In addition the laboratory in Sevilla is also providing the microstructural characterization with up-to-date electron microscopy facilities including a high resolution analytical TEM (Tecnai F30).

ii) Catalytic activity measurements for the combustion of lean H₂ fuel-air mixtures.

All the catalytic measurements will be carried out at EMPA during the 6 months stay in a systems consisting in a fluidized bed reactor. A monolith or a package of the catalyst/support will be use to investigated H₂/air premixed follows of a 1vol% H₂. Reaction and heat production take place along the monolith.

Catalytic activity is measured in this equipment through water production quantification in a dedicated FTIR equipment.