

IAF SPACE PROPULSION SYMPOSIUM (C4)  
Solid and Hybrid Propulsion (2) (4)

Author: Mrs. Nora Bierwagen  
DLR (German Aerospace Center), Germany, nora.bierwagen@dlr.de

Mr. Joël Martin  
Deutsch Luft und Raumfahrt Zentrum (DLR), Germany, joel.martin@dlr.de  
Dr. Andreas Ohndorf  
DLR (German Aerospace Center), Germany, andreas.ohndorf@dlr.de  
Prof. Christian Mundt  
Universität der Bundeswehr München, Germany, christian.mundt@unibw.de

A NEW CATALYTIC CHAMBER CONCEPT FOR MULTI-PHASE INJECTION OF HYDROGEN  
PEROXIDE**Abstract**

A catalytic chamber is a chemical reactor that decomposes hydrogen peroxide to gaseous oxygen and water vapor. It is filled with a catalytic material, for example metallic coated aluminium oxid buffer. The decomposition process is very reliable and easy because it is based on a catalytic reaction between the hydrogen peroxide and the metal.

The catalytic chamber is the main component for monothruster engines with hydrogen peroxide, with the exhaust gases used for thrust generation. For hybrid rocket engines, which uses hydrogen peroxide as oxidizer, the catalytic chamber is positioned before the combustion chamber and realizes the gaseous injection of oxygen to the fuel in the combustion chamber. The advantage of using a catalytic chamber lies in an automatic ignition without additional igniter.

The new catalytic chamber concept is only relevant for the application to hybrid rocket engines. The idea is to bypass some of the liquid hydrogen peroxide next to the catalytic bed in the catalytic chamber. With this bypass a multi-phase, liquid and gaseous hydrogen peroxide, injection in the combustion chamber is possible. The idea is based on the discovery of the positive effect of liquid injection on the combustion process efficiency [1].

In addition to the potential advantages, the new catalytic chamber also brings some disadvantages. First the construction space of the catalytic chamber must be subdivided into two independent flow tubes. One flow tube is filled with the catalytic material and the other one without. Second the flow tube with no catalytic material needs an atomizer to sputter the liquid hydrogen peroxide to a spray with fine drops. This is required so that the fuel in the combustion chamber is not flooded with liquid hydrogen peroxide which might stop the combustion process. Third the very reliable ignition process of the catalytic chamber with the fuel must not be affected negatively. To overcome these shortcomings a new design is required to use the advantage of a multi-phase flow injection.

## References

- [1] Lin, J. L.: Two-phase flow effect on hybrid rocket combustion. In: Acta Astronautica 65. 2009