Chair of Space Propulsion and Mobility (Prof. Manfletti)
TUM School of Engineering and Design
Technische Universität München

Semester/Master Thesis

Design and Experimental Testing of a Piston Tank for a Water Electrolysis Propulsion System

Topic

One of the most promising technologies in the ongoing search for high-performance green propellants is the Water Electrolysis Propulsion technology (WEP). The fundamental concept of such a system is to fill the spacecraft on ground with pure water instead of highly toxic propellants. Once the spacecraft is in orbit an electrolyser is used to split up the water into gaseous hydrogen and oxygen. The gases can then be used in a chemical or electrical thruster to propel the spacecraft.

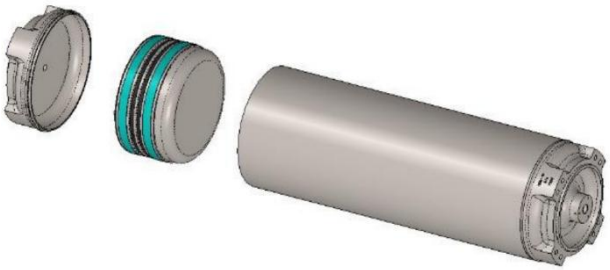

Figure 1: Example of a piston tank for spacecraft propellants [1]

Within the Ice2Thrust project the Chair of Space Mobility and Propulsion is currently developing such a Water Electrolysis Propulsion system with the goal of a future in orbit demonstration within a CubeSat. A major component of this system is the tank that stores the water and the produced gases. However, such small and lightweight tanks are commercially not available and their importance is generally underestimated. This thesis shall therefore develop, manufacture and test a suitable tank for the WEP system. In particular, a special piston tank shall be developed, which is be able to store H2, O2 and H2O in separate compartments within the same tank (i.e. having 2 pistons). Such a tank would provide multiple advantages and would enable multiple re-fillings in In-Orbit Servicing scenarios.

Tasks

- Familiarization with the WEP system and respective tank requirements
- Literature Review of current propellant tank types for small satellites, as well as of the state of the art in the design of piston tanks
- Identification of suitable tank materials as well as sealing designs incl. a subsequent selection based on a trade-off analysis
- Design and manufacturing of a flight-like piston tank compatible with a CubeSat
- Experiment design and testing of the manufactured piston tank under representative conditions (i.e. incl. operation cycle using actual gases in our vacuum chamber)
- Experiment design and testing of the material compatibility of tank membranes, which can serve as alternative tank design
- Evaluation of experimental results and derivation of required design improvements
- Documentation and presentation of the work

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