Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Liquid Oxygen Droplet Combustion in Hydrogen under Microgravity Conditions[1] FLORIAN MEYER, CHRISTIAN EIGENBROD, ZARM Center of Applied Space Technology and Microgravity, VOLKER WAGNER, WOLFGANG PAA, IPHT Leibniz Institute of Photonic Techology, JAMES HALL, MICHAEL ZODY, JON FRYDMAN, JAMES HERMANSON, University of Washington — In liquid rocket propulsion the liquid oxygen (LOX) and liquid hydrogen system is widely used. Single oxygen droplets burning in gaseous hydrogen surrounds are investigated, representing the most basic element of this spray combustion process. The basic processes of droplet vaporization, mixture formation, ignition and combustion under cryogenic conditions in microgravity are studied. Experiments in the ZARM 4.7 s drop tower are conducted using a cryogenically-cooled test chamber that allows for pressures up to 60 bar. Initial experiments indicate that the hydrogen-oxygen diffusion flame is formed relatively close to the droplet surface. During the combustion process the surface of the LOX droplet appears to become covered by a water-ice layer, which ruptures to produce discrete, gaseous oxygen jets. External to the flame zone, the water vapor combustion product is observed to condense or freeze, forming a spherical shell around the burning droplet. The flame standoff distance and the droplet regression rate are investigated with shadowgraphy and OH chemiluminescence imaging. The experimental results are compared with the findings of numerical simulations conducted by the University of Washington.

[1]This work is supported by the DLR (Project 50 WM 1645) and the US Fulbright Program.

James Hermanson
University of Washington

Date submitted: 30 Jul 2019 Electronic form version 1.4