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Development of a 200 Newton Bipropellant Thruster Using Heterogeneous Catalytic Reduction of Hydrogen Peroxide

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Abstract

This paper describes a demonstration-scale thruster that has been developed as part of a major European project aimed at utilising propellants of low toxicity, often referred to as 'green propellants'. The author's company, DELTACAT Ltd, is a member of the GRASP Consortium, which is funded under the European Commission's FP7 Programme [1]. The Consortium as a whole is focusing on different aspects of green propulsion systems. These cover the use of ionics, hydrogen peroxide and a host of catalysts and fuels. The resulting demonstration-scale (or elegant breadboard - EBB) thrusters fall into one of three classes - monopropellant, hybrid and bipropellant. The present paper describes the development and test results for a bipropellant thruster based on several low-toxicity fuels, hydrogen peroxide and a selected heterogeneous catalyst.

The paper describes a number of assessments that needed to be made before the design process could be started. These were:

- the mathematical description of the thermo-chemical process
- the problem of cooling
- the choice of catalyst and the sizing of the catalyst chamber
- the determination of the geometries for the combustion chamber and nozzle
- the method of fuel injection
- the problem of thrust control

The paper then describes the detailed design, production (see Figure 1), commissioning and testing processes. At the time of writing the thruster has been fired 10 times, six of these in bipropellant mode. Two different candidate 'green' fuels have been tested so far. A picture of one of these firings is shown in Figure 2. The results to date suggest that more refinement of the method of fuel injection is needed. A new injector will be tested in the coming weeks and the new results will be reported in the full paper.

Acknowledgements

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References

[1] GRASP - 'Green Advanced Space Propulsion', European Commission 7th Framework Programme, Theme 9, Grant Agreement Number 218819, 2008.

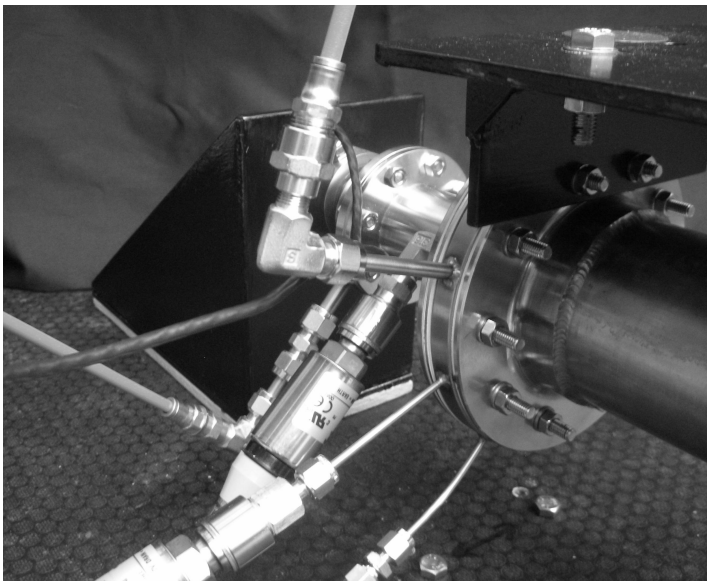

Figure 1. DELTACAT's 200 Newton GRASP EBB Thruster (rear bulkhead view)

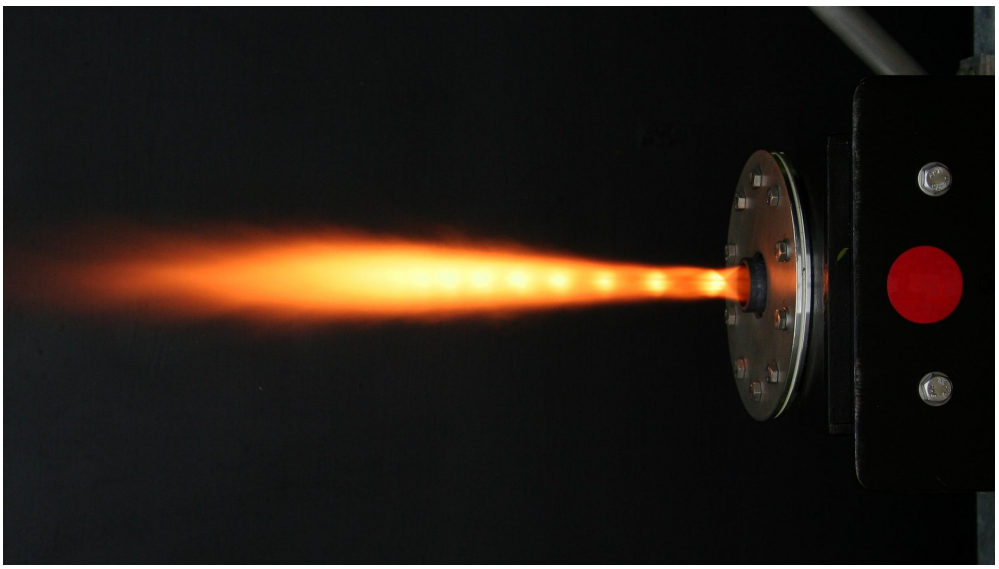

Figure 2. Plume Image for DELTACAT's 200 N GRASP EBB Thruster