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STUDY AND ANALYSIS OF MEMS-BASED MICROVALVE FOR PROPULSION SYSTEMS

Abstract

In this paper, we will discuss the development of a microvalve to regulate the flow in propulsion systems intended for space application. In the last two decades, there has been a paradigm shift in space industry from large conventional satellites to smaller miniaturised versions owing to its potential to allow for cost-effective implementation and faster development time. Delft University of Technology is currently developing an innovative green propellant driven micro-propulsion systems based on Microelectromechanical system (MEMS) technologies for its PocketQube called Delfi-PQ, a standard with a 5x5x5 form factor. Even though the actual thrusters are developed, the interfacing and integration to other components is still under development. For the successful operation of these micro-resistojets, robust and reliable microfluidic components need to be developed. Currently, no commercially available microvalves meet the size and performance requirements posed by the Delfi PQ.

TU Delft is focusing its research on analysis and developments of microvalves with minimum leak rates and integration in the same microchip as the actual thruster. This paper will provide a brief review of the current microvalve actuation concepts and the preliminary design of tightly integrated MEMS-valves suitable for a flow rate of 3-4 g/hr., power consumption of 5 W and maximum operating pressure of 5 bars. The related technology approaches employed include MEMS fabrication techniques and manufacturing processes available at the TU Delft's Else Kooi Laboratory. The integration challenges arising due to the wafer bonding of these miniaturised valves in the same package as the thruster and limitations in the technology available for the package assembly processes will also be addressed in this paper.