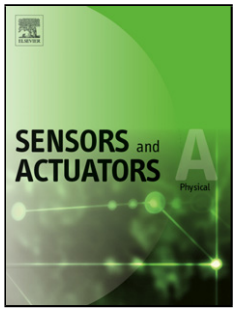

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High performance microthruster with ammonium-dinitramide-based monopropellant

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Highlights

- An ammonium dinitramide based monopropellant was used to develop a microthruster.
- The microthruster was manufactured using a MEMS process.
- A lanthanum doped Pt/Al_2O_3 catalyst was applied to increase the heat resistance.
- The thrust and specific impulse increased compared to H_2O_2 microthruster.

Abstract

A high performance environmentally friendly ammonium dinitramide (ADN) based liquid monopropellant was used to develop a thruster with improved performance compared to a conventional hydrogen peroxide propellant microthruster. Compared to regular thrusters, microthrusters have high heat loss due to the higher reactor surface area to volume ratio. A high enthalpy propellant needs to be used to increase the decomposition temperature in order to enhance the thruster performance. There is a need to increase the heat tolerance of the catalyst given the increased reactor temperature. A lanthanum doped Pt/Al_2O_3 catalyst was fabricated and applied to increase the heat resistance performance against the ADN-based propellant with a theoretical adiabatic decomposition temperature of 1630 ˚C. The microthruster was manufactured using a MEMS process. A total of five layers of photosensitive glass with different shapes were fabricated by wet etching and stacked and adhered, and sensors were assembled to measure the pressure and temperature. A combustion experimentation was carried out. 90 wt.% hydrogen peroxide was injected in advance for catalyst preheating and then the ADN-based propellant was injected. In the experimental results, ignition was observed within the reactor and the combustion temperature was 983 ℃. The thrust and specific impulse performances were obtained. Compared to a microthruster using 90 wt.% hydrogen peroxide, the ADN-based propellant enhanced thrust by 19 % while the specific impulse increased by 86 %.

Keywords: Microthruster

Ammonium dinitramide (ADN) based monopropellant

Platinum/alumina/lanthanum catalyst

Nomenclature

A_2	nozzle outlet area
A_t	nozzle throat area
C^*	characteristic velocity