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Tunable Water-based MicroThruster Array

Water-based microthruster array provides safe, tunable CubeSat propulsion with low power consumption and no moving parts.

Researchers at Purdue University have developed a highly tunable water-based microthruster array capable of generating thrust within a vacuum. The thruster uses ultra-pure deionized water as a safe and abundantly available propellant source and requires less than 1 watt of electrical power to operate. Thrust output can be dynamically adjusted from the micronewton range up to the millinewton range thus making it well suited for highly precise attitude control and maneuvering of CubeSats. Each thruster is microfabricated on 1 cm x 1 cm x 1 mm silicon chips with a mass of 200 mg. Thrust is generated by using platinum electric heating elements to vaporize the water propellant within micrometer scale silicon capillaries etched into each chip. When not heated, the high surface tension of water prevents the liquid propellant from being expelled through the hydrophobic capillaries. The thruster array does not require any moving parts to fire which allows it to pulse quicker than existing alternatives such as cold/warm-gas or electro-thermal thrusters and therefore offer a greater degree of controllability. Additionally, the chips are created in batches using standard microfabrication techniques which are commonly employed in the microelectronics industry thus resulting in relatively low unit production costs.

Technology Validation: Prototypes of different nozzle dimensions were generated to study microcapillary action and simulate how the technology may function in space. Thrust efficiency was measured in relation to varied inputs of power.

Advantages

-Highly tunable thrust in vacuum

-Low power consumption

-Compact form factor

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Category
Aerospace & Defense/Hypersonics & Propulsion Systems
Aerospace & Defense/Spacecraft Systems & Satellite Technologies

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-Spaceflight

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