Microelectronic Device for Spacecraft Thermal and Attitude Control

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- Aeronautics

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- Thermal

The growing field of miniaturized satellites and picosats demands unique propulsion systems options due to the small size, typically the size of a soda can, and low power availability. Current chemical propulsion options are too bulky and do not offer fine tuning of thrust for the tiny spacecraft mass and electrical propulsion options demand bulky solar arrays and power supplies that are not viable at this mass/size scale. As a result, an efficient picosat propulsion mechanism is needed.

Researchers at Purdue University have developed a novel picosatellite propulsion mechanism that not only provides thrust, but also spacecraft thermal control. This new design, known as the Film-Evaporation MEMS Tunable Array (FEMTA), exploits the use of microscale surface tension forces to eliminate propellant valves and unique physics of microscale evaporation to provide repeatable micronewton thrust pulses using only milliwatts of input power. Highly repeatable operation of this MEMS device was first demonstrated in 2015 using the simplest of working fluids, water. In addition to the propulsive capabilities offered by the device, the heat of vaporization of the working fluid provides the capability to absorb waste heat of the satellite, effectively providing thermal control. This FEMTA concept utilizes the MEMS fabrication process to integrate its various components in a compact system. This new propulsion and thermal control mechanism allows for the continued development and advancement of small spacecraft in many areas, ranging from orbital maneuvering to picosat formation flying.

To view a video related to this technology, click on this link: https://youtu.be/zP72l08yD3Q

Advantages:
-Small, compact size
-Highly efficient
-Utilizes MEMS fabrication

Potential Applications:
-Picosat thermal management
-Micropropulsion
-Attitude control

Related Publications:
Katherine Fowee, et. al. (2017, August). Quad-Thruster FEMTA Micropropulsion System for CubeSat 1-Axis Control. Paper presented at the 31st AIAA/USU Conference on Small Satellites, Logan, Utah. Abstract retrieved from http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=3544&context=smallsat

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