

SPACE PROPULSION SYMPOSIUM (C4)  
New Missions Enabled by New Propulsion Technology and Systems (6)

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HIGHLY MINIATURIZED FEED PROPULSION SYSTEM (NANOFEEP) FOR ATTITUDE AND  
ORBIT CONTROL OF CUBESATS

**Abstract**

A highly miniaturized Field Emission Electric Propulsion (FEED) system is currently under development at TU Dresden, called NanoFEED. The highly miniaturized thruster heads are very compact and have a volume of less than 3 cm<sup>3</sup> and a weight of less than 6 grams each. One thruster is able to generate continuous thrust of up to 8  $\mu$ N with short term peaks of up to 22  $\mu$ N. The very compact design and low power consumption are achieved by using Gallium as metal propellant with its low melting point of approx. 30 C. This makes it possible to implement an electric propulsion system consisting of four thruster heads, a neutralizer and the necessary electronics on a 1U CubeSat with its strong limitation in space, weight and available power.[1]

Even formation flying of 1U CubeSats using an electric propulsion system is possible with this system, which will be shown through the example of a currently planned cooperation project between Wuerzburg University, Zentrum fuer Telematik and TU Dresden. It is planned to use the NanoFEED electric propulsion system on the UWE (University Wuerzburg Experimental) 1U CubeSat platform [2] to demonstrate orbit and two axis attitude control with the NanoFEED system. We will present the latest performance characteristics of the NanoFEED thrusters, the highly miniaturized electronics and the performance of a currently developed cold neutralizer chip using Carbon Nano Tubes (CNTs).

References [1] Bock, D., Bethge, M., and Tajmar, M.: "Highly Miniaturized FEED Thrusters for CubeSat Applications", Proceedings of the 4th Spacecraft Propulsion Conference, Cologne, May 19-22 (2014). [2] Kronhaus, I. and Schilling, K.: "Pico-Satellite Orbit and Attitude Control by Electric Propulsion", Automatic Control in Aerospace, Vol. 19. No. 1, pp. 277-282, (2013).