MICRO/NANO-PARTICLE FIELD EXTRACTION ACCELERATOR FOR PLASMA INJECTION*

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The Nanoparticle Field Extraction Thruster (NanoFET) is a technology under development that electrostatically charges and accelerates pre-fabricated, solid micro- and nano-particles. Particle propellant in dry powder form is fed towards charging sieves that disperse particle aggregates with the aid of piezoelectric-induced inertial forces. Individual particles undergo contact charging and are subsequently accelerated by the electric fields generated by stacked electrode gates. By using micro/nano-electromechanical (MEMS/NEMS) fabrication processes, NanoFET is intended to be a compact, flat-panel configuration that is potentially scalable for a variety of applications.[1]

Because the particulate propellant is electrostatically charged, its charge polarity and magnitude is readily adjustable with the charging electric field. The particle velocity and mass flow rate are governed by the applied acceleration potential and the piezoelectric frequency, respectively. NanoFET may be usable for applications involving particle injection into plasmas and have important advantages over gas or liquid storage and transport approaches.

Micron-sized particles have been successfully transported, charged, and accelerated in the laboratory under both atmospheric and vacuum conditions, and work is progressing towards scaling down the system to accommodate nano-particles. A key challenge to be addressed is overcoming inter-particle forces to permit acceleration of individual particles rather than agglomerations with a distribution of charge states.

1. T. Liu, G. Wagner, A. Gallimore, B. Gilchrist, and P. Peterson, "Mapping the Feasible Design Space of the Nanoparticle Field Extraction Thruster," IEPC-2009-004, 31st International Electric Propulsion Conference, Ann Arbor, MI, 20-24 September 2009.

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