Paper ID: 64221
oral
student

IAF SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (2) (6)

Author: Mrs. Nina Sarah Mühlich
FOTEC Forschungs- und Technologietransfer GmbH, Austria

Mr. Bernhard Seifert
FOTEC Forschungs- und Technologietransfer GmbH, Austria
Prof. Friedrich Aumayr
TU Wien, Austria

VERIFICATION OF SIMULATION MODEL BASED ON BEAM DIAGNOSTICS MEASUREMENTS OF THE IFM NANO THRUSTER

Abstract

The mN-FEEP thruster developed at FOTEC has a high mass efficiency and due to its operation in the low thrust regime, it is ideal for precision altitude control of spacecraft. The thruster is based on the liquid metal ion source (LMIS) technology, where liquid metal is used as propellant. The emitter consists of a porous tungsten needle crown wetted with liquid indium. High voltage is applied between the emitter and extractor electrode, which leads to a strong electric field. Ions are extracted from the needle tips and accelerated in the direction of the extractor electrode thereby generating the thrust. An integrated electric thruster exploiting this effect is for example the IFM Nano Thruster which was developed at FOTEC and was commercialized by the spin-off ENPULSION. Main drivers for precision control are the beam divergence angle, thrust vector alignment, the propellant mass efficiency and the power-to-thrust ratio. Another aspect to consider is the interaction of the beam with components of the spacecraft. Due to such interactions, solar panels or electrical instruments on board the spacecraft could be compromised. So far, there are only a few studies on the composition and behaviour of the thruster beam of a FEEP thruster. For the experimental investigation, a beam diagnostic system was developed at FOTEC. With this system, the spatial ion current density and the ion energy distribution of the beam of a single needle as well as of an entire crown emitter was observed. Based on these analyses, a particle tracing simulation model was developed to determine the theoretical ion current density distribution. The verification of the model shows that the divergence angle matches experimental results. In addition, it is possible to match other thruster parameters as well such as the electrode voltages or beam current. The setup of the simulation model and the calibration procedure will be presented. Furthermore, convergence tests of the verified simulation model will be shown. This simulation model will lead to a better understanding of the thruster technology and will be used to optimise the divergence angle of the thruster beam. For this purpose, a variety of parameters can be adjusted, such as the geometry of the thruster electrodes. This also allows to use the simulation model for various scientific missions to adapt the thruster properties to the specific requirements.