

Accepted Manuscript

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PII: S0273-1177(18)30582-9
DOI: <https://doi.org/10.1016/j.asr.2018.07.020>
Reference: JASR 13849

To appear in: *Advances in Space Research*

Received Date: 31 March 2018
Revised Date: 10 July 2018
Accepted Date: 19 July 2018

Please cite this article as: Li, W., Li, H., Ding, Y., Wei, L., Lu, H., Gao, Q., Ning, Z., Yu, D., An Experimental Setup for Hollow Cathode Independent Life Test Simulating Hall Thruster Discharge Current Oscillations, *Advances in Space Research* (2018), doi: <https://doi.org/10.1016/j.asr.2018.07.020>

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An Experimental Setup for Hollow Cathode Independent Life Test Simulating Hall Thruster Discharge Current Oscillations

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Abstract: The reliability of cathode is critical to electric propulsion systems. Although researchers have carried out many life tests on hollow cathode, the discharge current is almost steady when the cathode is independently tested for life. Actually, when it is coupled with the thruster, the discharge current is with large amplitude low-frequency oscillation. Therefore, we suggest a new external circuit for a cathode-independent life test, which could simulate the characteristics of discharge current oscillation when the cathode is coupled with Hall thruster. We carried out 160 hours of life test using the normal external circuit and the new external circuit, and the variation characteristics of the cathode orifice area are also studied during the life test. The results show that under the normal external circuit, the growth rate of the cathode orifice area initially increases and then decreases gradually with the increase of the time of life test, whilst the cathode orifice area in the new external circuit linearly increases. The new external circuit can provide a new method to simulate the discharge current oscillation when the cathode is coupled with Hall thruster during the independent life test of the cathode.

Keywords: New external circuit; Cathode-independent life test; Discharge current oscillation; Hall thruster

1. Introduction

Electric propulsion devices have been widely used for space propulsion missions such as satellite station keeping and orbit transfer because of their moderate specific impulse (in the order of 10^3 s), simple structure, and other characteristics (Yu et al., 2006; Wu et al., 2017; Kronhaus et al., 2012; Roy et al., 2015; Lemmer 2017; Levchenko and Xu et al., 2018; Choueiri, 2012). As an electron source and neutralizer (Levchenko and Bazaka et al., 2018; Grubisic and Gabriel, 2016;

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