

AMPULE CATHODE - NEUTRALIZER.

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Abstract

Creation of cathode-neutralizer operated in very low flow rates and with the current of dozens mA is the main task in working out of small size ion thruster. This problem arose when ions sources for international experiment "DION" of "FOBOS" project was made. The analysis of parameters of high-temperature thermo-cathodes has shown that they satisfy to requirements on resource and low reliability, since temperature necessary for maintenance of a sufficient level of electron current causes large erosion of cathode material. Therefore in quality of base variant was chosen compensator on the basis of hollow cathode with feeding of working medium.

Introduction

Modern tendencies in improving hollow cathodes are connected shock by using activating substances which decrease the average surface work function. Maximum improvement in cathode operating characteristics can be achieved by using alkaline metals as activators or working medium. It is known that for account orifice hollow cathodes exists minimum pressure in its cavity 1 Torr which will be realized effect of hollow cathode. Appropriate significance of electron current determine by concentration of plasma in cathode cavity is minimum possible. For conventional orificed hollow cathodes this value makes about 200mA and on the order exceeds required current of neutralizer. Thus work of cathode near the threshold of initiate arc is unstable.

By the purpose of decrease the minimum level of electron current and stabilization the work in cavity of cathode is entered internal discharge. In this case electrons emission goes from plasmas internal border under voltage applied between cathode and anode. Decrease of level the pressure in cathode cavity mass flow rate has allowed to reduce a necessary stock of working medium and pass to ampule designs of cathode. Ampule hollow cathode consists of internal and external cylinder type electrodes. There is an annular gap between the electrodes. An isolated cathode heater connected with the electrodes is installed there. An orifice for electron extraction out of cathode hollow is made in the external cathode. The pills with working medium is in the internal cathode hollow. At voltage supply cathode heater warms cathode and working medium goes to the cavity between electrodes. Heater resistance value is chosen of such type that internal discharge shunts it and the power released supports the necessary cathode temperature. Such system does not require additional control device. Thus the pressure drops in cathode hollow the voltage of internal discharge grows, the released head power increases and the temperature of the system is restored when temperature is lowering.

Conducted researches of parameters of ampule hollow cathode have shown that in quality of working medium it is necessary use salts of alkaline metals.

Conclusions

Thus the developed cathode-compensator has following parameters: electron current -20-30mA; discharge voltage - 15-20V; current of internal discharge - 2A; voltage of internal discharge - 5 - 6V; cathode temperature - 673-923K; mass flow rate - $5 \cdot 10^{-10}$ kg/s; input power - 10-15W.

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