

Mixed Matrix Dispenser Cathode for Application in Electric Propulsion System

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Abstract— Electric propulsion system is the most efficient thruster of satellite to control its orbits in deep space. Total efficiency, life and reliability are the key characterization parameters of an propulsion system which define its performance. Cathode which generate ions is a key component which determines the above performance. In this work possibilities of various kinds of electron emitter will be discussed in order to enhance the performance of propulsion system.

I. INTRODUCTION

Thruster is one of the critical component of a satellite which is mainly used to control its orbit (keeping and raising) of the satellites in deep space. Presently two types of thrusters viz. chemical thruster and electronic thruster are being used. Chemical fuel-based system occupies space and is heavy propellant mass, less life time of the propulsion systems and less payload for space operation. Above issues can be overcome using electronic thruster [1]. Among various kind of electronic thrusters, electric propulsion system is the most potential research area due to its high exhausts propellant velocity [2]. An electric propulsion system creates thrust by accelerating ions from electric power. In this type of system electrical power is used to create charged particles out of fuel, commonly xenon gas, which are accelerating to extremely high velocities. An electric propulsion system composes of cathode, discharge chamber, neutralizer and extraction grids [3]. A schematic diagram of an ion thruster is shown in figure 1.

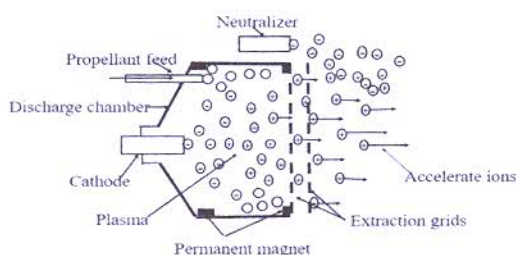


Figure.1 Schematic diagram of an ion thruster

Cathode emits electrons which collide with propellant gas and produce ions in the discharge chamber. Ions are extracted out from the discharge chamber using extraction grids with high exhaust velocity. cathode is one of the critical parameters which determines the performance, lifetime and efficiency of the propulsion system. In order to enhance these parameters, long life, reliable, and stable with uniform emission dispenser cathode is critical requirement.

CSIR-CEERI is working on design and development of reliable and long life dispenser cathode for microwave tubes. CSIR-CEERI successfully developed various kinds of cathode viz. Alloy coated, mixed matrix, control porosity and scandate type dispenser cathode. All these cathode are used in ultra high vacuum working environment. In present application the cathode will be used in plasma environment where probabilities of back ion bombardment is very high compared to conventional microwave devices. Therefore alloy coated dispenser cathode cannot be used due to back stream ion bombardment. Due to geometrical limitation control porosity dispenser cathode cannot be used. There is a poor poison resistance and patchiness of scandate cathode which will not use in plasma environment. The only possible candidate is mixed matrix dispenser cathode.

In this proposed work criticality and developmental challenges of mixed matrix cathode will be discussed.

II. EXPERIMENTAL WORK

The pellets were made out of W and Re and Os powders procured from Alfa Aesar. The average particle size of the metal powder was about 25 μm . The sequence followed in the fabrication of cathode is given below.

Mixing: The powders were taken in the equal atomic proportion and were mixed in a agate