CUBESAT PROPULSION SYSTEM

VACCUM EXPANDED THERM - IONIC THRUSTERS

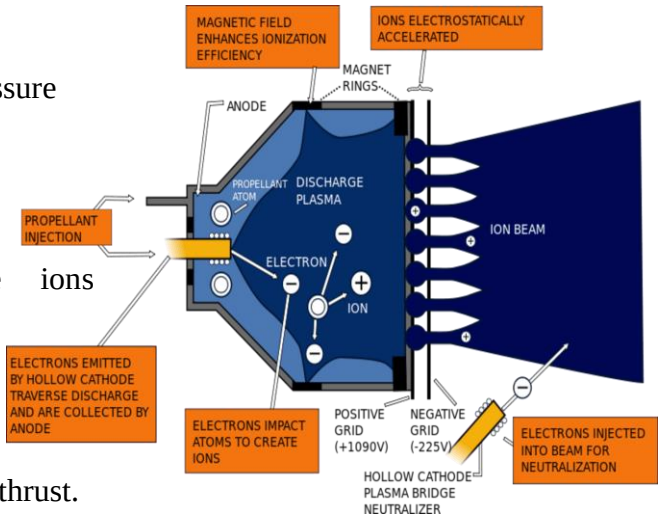
A *6U - CubeSat* is generally defined as a miniature satellite with a maximum weight of almost 6 Kg. To ensure the minimum weight factor, it is important that we implement lightweight materials with multi-functional capabilities for the manufacturing process.

Graphene is one of the lightest materials with excellent electrical, thermal and optical properties and high mechanical strength. Moreover, graphene ink can be used for printed electronics that consume less space, has more surface area for the thrusters. Due to viscosity and high surface tension, graphene ink is proven to be versatile enough to serve this purpose. *Lanthanum Hexaboride* and *Mylar polyester sheets* can be used for discharge tube fabrication and overall insulation purpose respectively.

It has been ages since the CubeSat propulsion techniques have only evolved and extended its domains. One of the most promising propulsion method is that of Ion thrusters. In our proposal, we present a ***Laser Induced Thermionic Electron Emission System for CubeSat Propulsion***. Implementation of high energy laser sheets not only helps in weight reduction but also provides the optimum conditions for plasma formation.

Basic principle is enlisted below:

- Laser induced plasma generation under pressure
- Bombarding of neutral gases (Kr)
- Electron emission [Kr+ + e-]
- High voltage accelerates the (+)ve ions exiting the chamber.
- Electromagnetic effects guide the ions in a pattern.
- High speed ion ejection to provide forward thrust.



For this system, we have planned a variable cross-sectional area design to make room for variable thrust operating conditions by means of pressure alterations which corresponds to the multiple speeds along the length of the tube and nozzle.

This setup apparently can eject ions at a speed over 30 km/s with significant contribution towards the forward thrust with *specific impulse ranging over 3000 seconds* which is considerably higher than the conventional propulsion techniques and subsequently consumes less power.

To increase the momentum of the exit ions further, a *vacuum annulus* can be used. The vacuum section not only increases the kinetic energy but also leads to ion expansion which corresponds to optimum pressure expansion.

In order to avoid overheating of the CubeSat, we propose the concept of *inter-surface refrigeration* by means of *Liquid Hydrogen* as a coolant.

This might revolutionize & replace the existing independent CubeSat propulsion systems in the near future.