**Miniature Lightweight Ion Pump**

This lightweight pump with no moving parts eliminates the need for a backup pump.

*NASA’s Jet Propulsion Laboratory, Pasadena, California*

This design offers a larger surface area for pumping of active gases and reduces the mass of the pump by eliminating the additional vacuum enclosure. There are three main components to this ion pump: the cathode and anode pumping elements assembly, the vacuum enclosure (made completely of titanium and used as the cathode and maintained at ground potential) containing the assembly, and the external magnet. These components are generally put in a noble diode (or differential) configuration of the ion pump technology. In the present state of the art, there are two cathodes, one made of titanium and the other of tantalum. The anodes are made up of an array of stainless steel cylinders positioned between the two cathodes.

All the elements of the pump are in a vacuum enclosure. After the reduction of pressure in this enclosure to a few microns, a voltage is applied between the cathode and the anode elements. Electrons generated by the ionization are accelerated toward the anodes that are confined in the anode space by the axial magnetic field. For the generation of the axial field along the anode elements, the magnet is designed in a C-configuration and is fabricated from rare earth magnetic materials (Nd-Fe-B or Sm-Co) possessing high energy product values, and the yoke is fabricated from the high permeability material (Hiperco®-50A composed of Fe-Co-V). The electrons in this region collide with the gas molecules and generate their positive ions. These ions are accelerated into the cathode and eject cathode material (Ti). The neutral atoms deposit on the anode surfaces. Because of the chemical activity of...
Ti, the atoms combine with chemically active gas molecules (e.g. N₂, O₂, etc.) and remove them. New layers of Ti are continually deposited, and the pumping of active gases is thus accomplished.

Pumping of the inert gases is accomplished by their burial several atomic layers deep into the cathode. However, they tend to re-emit if the entrapping lattice atoms are sputtered away. For stable pumping of inert gases, one side of the cathode is made of Ta. Impaction on Ta produces energetic, neutral atoms that pump the inert gases on the anode structure at the peripheral areas of the cathodes (between anode rings). For inert gases stability, a post design has been implemented. Here, posts of cathode material (Ti) are mounted on the cathode. These protrude into the initial part of the anode elements. Materials sputtered from the posts condense on the anode assembly and on the cathode plane at higher rates than in the normal diodes due to enhanced sputtering at glancing angles from geometrical considerations. This increases pumping by burial. This post design has enhanced pumping rates for both active and inert gases, compared with conventional designs.

This work was done by Mahadeva P. Sinha of Caltech for NASA’s Jet Propulsion Laboratory. In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to: Innovative Technology Assets Management JPL.
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
E-mail: iaoffice@jpl.nasa.gov
Refer to NPO-30628, volume and number of this NASA Tech Briefs issue, and the page number.