be reduced by lowering the impact energy of bombarding ions. This approach has been investigated in the SIT-8 and SIT-12 thrusters by biasing the thruster shell (including screen electrode) at keeper potential (rather than at cathode potential as in conventional SIT-8 design operation) and reducing the discharge voltage from $V_D = 40$ V to $V_D = 37.5$ V. As shown in Table 3, these changes reduced by threefold the rate of total discharge-chamber mass erosion. No significant performance penalty was incurred by this modification.

In larger thrusters, where Hg^{++} is the dominant sputtering agent, the Hg^{++} generation rate can be reduced by raising the neutral-mercury density in the discharge plasma. This, of course, means reducing the propellant utilization efficiency.§

Conclusions

The processes of discharge-chamber sputter erosion have been studied in small mercury ion thrusters using direct LTF measurements of the erosion rates and a correlated program of plasma measurements and modeling to interpret the erosion-rate data. The principal findings of the investigation are listed below:

1) In small thrusters, Hg^{+} is the dominant sputtering agent.

2) In small thrusters, the screen electrode is the surface that experiences the greatest amount of mass erosion. Erosion of the screen electrode is remarkably uniform.

3) A threefold reduction in discharge-chamber mass erosion rate has been demonstrated in small thrusters by operating the thruster with the shell maintained at keeper potential and reducing the discharge voltage from $V_D = 40$ V to $V_D = 37.5$V.

4) In larger thrusters, Hg^{++} is the dominant sputtering agent; Hg^{++} generation is primarily a function of the Hg^0 to Hg^+ density ratio, n_0/n_+, and is only weakly dependent on discharge voltage.

5) Discharge-chamber sputter erosion is not life threatening for small thrusters and is readily dealt with by existing sputter-control methods.

§Loss of propellant utilization due to increased neutral density can be avoided to some extent by reducing the accel transparency (i.e., reducing the neutral-loss open area) as in the use of an ion-machined extraction system.[11]

Acknowledgments

Special acknowledgment is due H. L. Garvin who developed the required techniques for deposition of multilayer films on sample surfaces and invented the diagnostic-etch procedure, which was essential to the success of the subject investigation. This paper is based on work performed under the sponsorship of the International Telecommunications Satellite Organization (INTELSAT). Any views expressed are not necessarily those of INTELSAT.

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