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Brief 68-10214

NASA TECH BRIEF

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Reducing Bubbles in Glass Coatings Improves Electrical Breakdown Strength

Recent investigation of fused glass coated accelerator grids for ion thrusters, has shown that elimination of the naturally occurring bubbles in the fused glass coating can increase its effective electrical breakdown strength by over 800 percent.

The fused glass coatings are obtained by spraying a powdered glass and water slurry onto the metal grid. The coating is dried in air and then heated in an oven to fuse the glass particles to each other and bond the coating to the grid. During this process, air or inert gas is entrained in the slurry, resulting in small gas-filled bubbles trapped in the fused glass coating. When a high electrical potential is imposed across the coating, the bubbles become potential electrical breakdown sites. If an electrical discharge occurs within a bubble, the conductivity of the plasma in the bubble reduces the breakdown strength of the coating in a line through the bubble. Thus, either relatively large bubbles or a multiplicity of smaller bubbles can significantly reduce the effective electrical breakdown strength of the coating.

A new technique for eliminating the bubbles is based on the very high diffusion rate of helium through the glass at elevated temperatures. The sprayed-on slurry coating is first fused in a helium atmosphere during which time helium bubbles are formed in the glass. The helium atmosphere is then changed to an argon atmosphere to provide an environment with zero helium partial pressure. The entrapped helium diffuses out of the glass and the bubbles collapse. The result is a nearly bubble-free coating with a substantially enhanced electrical breakdown strength.

These glass coatings have good sealing and bonding properties, can withstand high temperatures, and have high electrical breakdown strength for small thicknesses. This invention should be useful for many electrical and electronic applications in addition to accelerator grids.

Notes:

1. The effective breakdown strength has been increased over eight times by reduction of the bubbles. The effective breakdown strength of the coatings made by this helium diffusion process is 8.75×10^7 volts/meter for coatings of approximately 0.035 centimeter thickness.
2. The technique of applying the fused glass coatings to charged particle accelerator grids which resulted in a successful single grid accelerator system is described in Tech Brief 68-10215.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B68-10214

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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Category 03

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