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Study of Initiation Conditions of Electrostatic Discharges under Combined Irradiation of K-208 Glass by Electrons and Protons

R.H. Khasanshin[1], L.S.Novikov[2], S.B. Korovin[3]

[1]JSC "Kompozit" (Russia); [2]Lomonosow Moscow State University, Skobeltsyn Institute of Nuclear Physics (Russia); [3]Prokhorov General Physics Institute, Russian Academy of Sciences (Russia)

Irradiation of low-conductive dielectric by charged particles which track lengths do not excess the sample dimensions results in formation of areas with high density charge. The field induced by the accumulated charge can initiate the electrostatic discharge between the charge location area and surface of the dielectric. The study of electrostatic discharges in low-conductive dielectrics under radiation is essential both from a scientific point of view and for the solution of applied problems. In particular, interaction of a spacecraft with ambient plasma causes accumulation of electric charges on its surface producing, as a consequence, electric potential between the spacecraft surface and the plasma. Initiation conditions and features of evolution of electrostatic discharges on surface of K-208 glass used as the protective covering of spacecraft solar arrays, under combined irradiation by electrons and protons in vacuum were studied in this work. Energies of electrons and protons were 40 and 20 keV respectively. The particle beam current was varied within 1.5 ÷ 150 nA. Surfaces of irradiated samples were studied by AFM methods. It was shown that changes of sample morphology due to radiation are determined by radiation annealing of defects in the near-surface layer of the glass, mass transfer processes accompanying by forming various structures on its surface and electrostatic discharges, surface modification having depended on radiation type and intensity. It was ascertained that microprotrusions either presenting on glass surface due to the process of its fabrication or appeared at the early stage of irradiation promotes discharge development.

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