SYNERGISTIC EFFECTS OF ELECTRON AND PROTON RADIATION ON THE OPTICAL MATERIALS

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The irradiation and simulation experiments of electrons and protons alone or together irradiated on optical quartz glass were carried out by using the space integrated irradiation simulator. It was found that there were complex synergistic effects in optical materials when electrons and protons were irradiated at the same time. When irradiation dose was less than $2 \times 10^{15}$ Part./cm$^2$, the change in spectral transmittance of quartz glass due to the complex irradiation of proton and electron was greater than summation of the single irradiation of each species. Comprehensive irradiation has an enhanced effect on the coloring effect of optical materials. On the contrary, when irradiation dose was greater than $2 \times 10^{15}$ Part./cm$^2$, the change in spectral transmittance of quartz glass due to the complex irradiation was lower than summation of the single irradiation of each species. The effect of comprehensive irradiation on the coloring effect of optical materials became weakened. Further analysis showed that the absorbed dose rate of optical materials increased on the situation of the electron and proton comprehensive irradiation, which increased the formation rate of color center and quickly raised the optical density when less than the critical dose. When reaching the critical dose, the increase in the number of color centers slowed down, and the additional temperature rise under comprehensive irradiation promoted the annealing effect of the color center and slowed the growth of the optical density.

Key words: electron and proton irradiation, synergistic effect, quartz glass, color center, optical density