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Testing of ZnSe, CaF₂, BaF₂, and sapphire windows under alpha particles irradiation

Dan Sporea¹, Laura Mihai¹, Adelina Sporea¹ and Ion Vătă²

¹National Institute Laser, Romania

²National Institute of Physics and Nuclear Engineering, Romania

In the last decade experts' attention was focused to applications of mid-IR spectroscopy to astronomy, astrophysics, astrochemistry, and space missions, for (i) the detection of gas and dust located into deep space, (ii) planetary atmosphere gases tracing and identification through their vibration or rotation spectra, which abound in the 3 μm to 12 μm spectral windows. Within this context we started some tests to evaluate the degradation of several materials for mid-IR (ZnSe, CaF₂, BaF₂, and sapphire) windows under various types of irradiations: alpha particles, gamma and X-rays, electron beams (grant 67/2013 of the Romanian Space Agency). The present contribution reports for the first time the results of the test we run under 3 MeV alpha particles exposure. Pre and post irradiation measurements were performed off-line for spectral transmittance and spectral reflectance (total, specular and diffuse), over the spectral range from 250 nm to 18 μm . The optical investigations were complemented with THz investigations of the irradiated samples, at 0.2-2.4 THz: Spectral transmittance, spectral absorbance, refractive index, dielectric constant. THz imaging was also used to evaluate the irradiated zone. In all cases, computer simulations were performed to estimate the alpha particles penetration depth and the number of the vacancies produced during the irradiation at fluencies of $0.9 \times 10^{15} \alpha/\text{cm}^2$.

Biography

Dan Sporea received the MS degree in Electronics Engineering ("Politehnica" University, Bucharest, 1972), and a PhD degree in Physics Engineering (Institute for Atomic Physics, Romania, 1992). He is heading the Laser Metrology Laboratory, at the National Institute for Laser, Plasma and Radiation Physics. He coordinated several research projects for the European Fusion Program and over 15 national projects related to laser metrology, radiation effects in devices and materials, optical fiber sensors for critical installations. He holds one American patent and over 20 Romanian patents. He co-authored book chapters on optical information processing, optoelectronics, optical fiber and optical fiber sensors in radiation environments.

dan.sporea@infpr.ro

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