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EFFECTS OF ArF EXCIMER IRRADIATION ON MULTI-ENERGY Ge AND Se ION IMPLANTED SILICA

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The discovery of photosensitivity in glass in 1978 by Hill and his colleagues, leading to the development of fiber Bragg gratings, is one of the key materials advances underlying the unfolding telecommunications revolution. Devices using photoinduced gratings have been demonstrated or postulated as new ways of optical switching and pulse compression, and as arrays of devices for signal processing in fiber and waveguide systems. At present the models used to explain the process of forming Bragg gratings in optical fibers and waveguides invoke the photosensitivity of defect structures to UV irradiation by either a densification process or a bleaching process. Implanting silica with Si, Ge, O, or H ions has been shown to produce photosensitive defects in silica. Changes in the index of refraction, Δn, of ~ 0.1 % under 6.4 eV excimer radiation have been reported and attributed to the photo-bleaching of oxygen related defect centers formed during implantation.

We examine the effects of ArF excimer irradiation on the optical bands produced by multi-energy (highest energy 4 MeV) Se and Ge implantations in Type III silica. We have chosen these two ions because, while the mass and nuclear charge of Ge and Se are comparable, resulting in similar radiation damage during implantation, the chemistry of these two ions is significantly different. Ge has been shown to substitute for Si in the network, while Se can be expected to replace O.

We fit the observed optical spectra of samples, after implantation and subsequent ArF exposure, to the minimum number of bands attributed to intrinsic states in SiO_2 required to fit the data within $\pm$ 2 %. The response of these absorption bands to the ArF irradiation was confirmed to be a function of the ion species.

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