은 입자 함유 유리의 광학적 특성

Optical Properties of Silver Particle Containing Glass

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Metal nanoparticle doped glasses have various applications such as use as photochromic media for optical disk data storage[1], the fabrication of optical waveguides and waveguide lasers,[2] use as all-optical switches due to their nonlinear optical properties,[3] as well as use in the color glass recycling industry.[4] Recently, an ultrashort pulsed laser has been used as a powerful tool to make microscopic modifications to transparent Metal nano particle doped glasses. Moreover, photosensitivities in glass materials induced via irradiation with ultrashort laser pulses have been of great interest, because of large third-order nonlinear susceptibility. For instance, Gonella et al.[5] observed permanent changes in the optical properties of glass after laser irradiation and co-workers demonstrated a three-dimensional optical storage inside transparent materials, while Miura et al.[6] succeeded in a fabrication of optical waveguide in various glasses. Though the exact mechanisms responsible for the photosensitivities are still under investigation, the phenomena must be related closely to nonlinear optical process, such as multiphoton absorption/ionization, being due to extremely high field intensity of the ultrashort laser pulse.

In this study, we investigate the photosensitivity and photo bleaching by light irradiation of a zinc phosphate glass containing only silver and silver ions without any other reducer. Absorption of the glass can be increased well by gamma ray irradiation and the color turn into yellowish brown from transparency. Moreover, the increased absorption can be decreased through nanosecond pulsed UV laser irradiation at moderate intensities. Again absorption of the glass recovers by gamma ray irradiation. This shows that we can control the absorption property of silver containing glass and photosensitivity of the glass simply through only light irradiation. To our knowledge, this method has not yet been reported in other previous glass systems. Next, we report on an intensity-dependent photo bleaching in the glass with near-UV nanosecond pulsed laser. As pulses of irradiation with the near-UV lser beam increases, the absorption coefficient at the surface plasmon resonance decreases and eventually saturates.Irradiation with the near-UV pulses results in formation of silverless region, of which the population density decreases proportionally with averaged power of incident laser beam. Also, we observe space-selective photo bleaching of the irradiated

portion inside the glass by focusing laser beam through a microscope objective lens, which demonstrate the creation of localized spot and control of silver nano particles. Finally, the magnitude of difference between the initial and saturated absorption increases with averaged power of incident laser beam. We fit the magnitude of $\Delta\alpha$ as a function of intensity of incident laser beam and confirm that the model based on two photon absorption go with well experimental results.

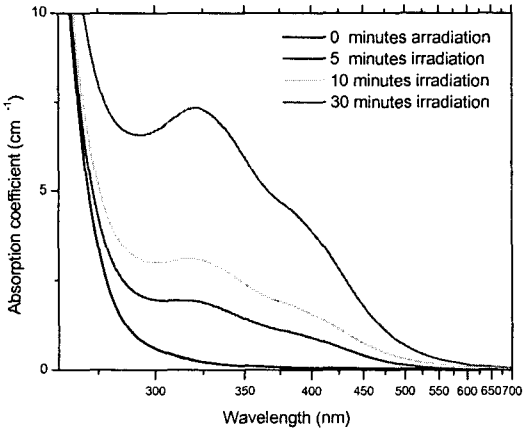

그림 1. Absorption spectrum of glasses after gamma ray irradiation

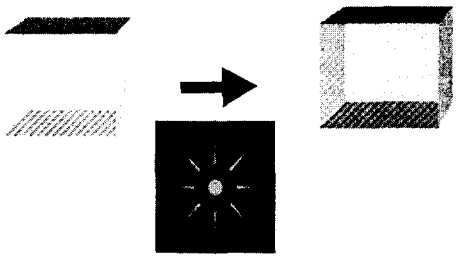

그림 2. Collorization of the glass after gamma ray irradiati

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