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Novel polarization dependent photoinduced effects in glass

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For centuries oxide glasses have been used successfully in windows, thus indicating that they remain stable, unlike plastics, against exposure to sunlight. By comparison, the structure and properties of closely related chalcogenide glasses are easily altered by exposure to visible light of energy $\geq$ bandgap of the material. In general, such photoinduced changes may be classified into three categories depending on their stability: (a) permanent changes which cannot be recovered unless the sample is melted and prepared again, (b) metastable changes which can be reversed by heating the sample to the glass transition temperature, and (c) temporary changes which can be reversed simply by removing the light source, or exposing the specimen to another appropriate light subsequently. Among the numerous photoinduced phenomena, the photoinduced vector effects like anisotropic light transmission, mass transport, opto-mechanical effect, etc. are particularly fascinating as they depend on the direction of light polarization in spite of the isotropic glass structure. The transient 'vector' optical effects, which are produced by linearly polarized light and then erased by either unpolarized or circularly polarized light, are even more intriguing and novel. This paper will review the various observations of photoinduced vector effects. It will then focus on the origin of such effects, which we have sought by probing the changes in atomic and electronic structure under in situ laser irradiation.