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Tuning the properties of glasses through light-generated defects

Glasses flee from a simple classification within the traditional states of matter such as solids, liquids, or crystalline structures. Their distinctive lack of long-range order sets them apart from crystalline solids on the one hand, while their extremely high viscosity distinguishes them from common liquids on the other. The disordered atomic arrangement of glasses sets off several interesting properties and makes glasses both scientifically captivating and technologically relevant. For instance, worldwide nowadays communication systems massively use optical fibers for data transport, exploiting the physical peculiarities of amorphous glasses for light transmission.
It is well known that many properties of amorphous materials are tunable via appropriate protocols involving, for example, the temperature: a well annealed glass has generally an improved transparency compared to a highly-quenched one. The objective of precisely tuning the properties of a glass can be achieved in alternative ways: the generation of defects through irradiation represents an intriguing one. As photons penetrate the glass matrix, they trigger the formation of defects and the emergence of novel structural motifs. Among all the different parameters playing a role in this complicated game, the wavelength and polarization of the incident beam give interesting insights on the physics of such structural rearrangements. The choice of the wavelength is crucial, as it determines the penetration depth and energy deposition within the glass matrix on the one side, and influences the type and density of generated defects on the other. Controlling the polarization of the incident light allows for precise manipulation of the orientation and symmetry of the defects.
The goal of tailoring the properties of glasses through light thus begins with the understanding of the mechanism generating such defects born from the interplay of photons with the glass matrix atoms.

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