# Direct Laser Writing surface microstructuring of silver-doped phosphate glasses for optical functionalities

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Direct Laser Writing (DLW) of micro- and nano-structures for photonics is challenging and relies on the control of the local electron/hole trapping, phase separation and diffusion processes. Femtosecond laser structuring applied to silver-containing tailored glass allows creating a variety of photo-induced species or nanoparticles. Such materials becomes then unique to implement three-dimensional optical structures with luminescence and nonlinear optical properties with dimensions below the diffraction limit using IR femtosecond laser [1, 2, 3].

By adjusting the glass composition and the laser dose (fluence, number of pulses and repetition rate), the intense fluorescent structure, made of silver aggregates, can be achieved thanks to oxidation/reduction processes and local heating. The process allows tailoring of the luminescence property at the nanometer scale (intensity, spectrum, spatial distribution). The repetition rate of the lasers and the glass composition are identified as key parameters for tailoring the resulting photonic property.

Different properties can be implemented such as luminescence and second order nonlinearity. The understanding of the direct laser writing processes rely on the relationship between the glass composition and the laser material interaction phenomena. Pristine glass structures and photo-induced modifications will be presented and the photo-induced mechanisms discussed. Introduction of rare earth or gold ions in glass have been investigated in order to take advantage of the silver ions reactivity toward femtosecond laser exposure. The fabrication of photo-sensitive silver-containing glass fibers has been developed and direct laser writing procedures has been applied on the fiber [3]. Correlation have been established between fiber architectures, materials chemistry and photonics properties.

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