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Silver photochemical reactivity analysis in electron-irradiated gallo-phosphate glasses

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Nowadays photonics is becoming a key enable technology for the future thanks to its ubiquity in a vast spectrum of disciplines. The development of new functionalities in integrated phonic circuits remains highly challenging in order to push photonics technology out of its limit, up to a mature level for industrial transfer. In this framework, the ability to use fs-laser writing for shaping and inscribing functionality in glass material has open a way for the versatile production of multi-scale subwavelength photonic architectures. Recently we demonstrated the possibility to create multi-scale 3D architecture with highly localized fluorescence contrast in photosensitive silver-containing gallo-phosphate glasses by means of all-optical femtosecond laser writing¹. Femtosecond laser interaction with glass creates highly out-of-equilibrium free electrons that allow for the activation of silver-based photo-chemistry. In this framework, it is highly interesting to perform high-energy ionizing irradiation to access to the initial mechanisms of material modification, and thus to provide the fundamental understanding of the material parameters that play a role in glass photosensitivity. In the present work, we will present the results obtained on electron-irradiated glass samples (Ag-doped gallophosphate and Bi-Ag codoped phosphate) being analyzed by cathodoluminescence and EPR spectroscopy. This allowed for understanding the initial phenomena of electron deposition and charge trapping that support the photosensitivity of these glasses by identifying the nature of point defects and Ag species, which are formed². The in-situ cathodoluminescence measurements on SIRIUS accelerator gives additional valuable information about the cascade of chemical reactions in the formation of bismuth and silver species, namely from the initial silver ions to the molecular silver clusters.

1. T. Guérineau, L. Loi, Y. Petit, S. Danto, L. Canioni, and T. Cardinal, *Laser Direct Writing of Silver Clusters-Based Subwavelength Periodic Structures Embedded in Mid-Infrared Gallo-Germanate Glass*, Opt. Mat. Expr. **8**(12), 3748-3760 (2018).
2. F. Alassani, J-C. Desmoulin, O. Cavani, Y. Petit, T. Cardinal, N. Ollier, *Silver photochemical reactivity under electronic irradiation of Zinc-Phosphate and Sodium Gallo-Phosphate glasses*, Journal of Non-Crystalline Solids 600 (2023) 122009.