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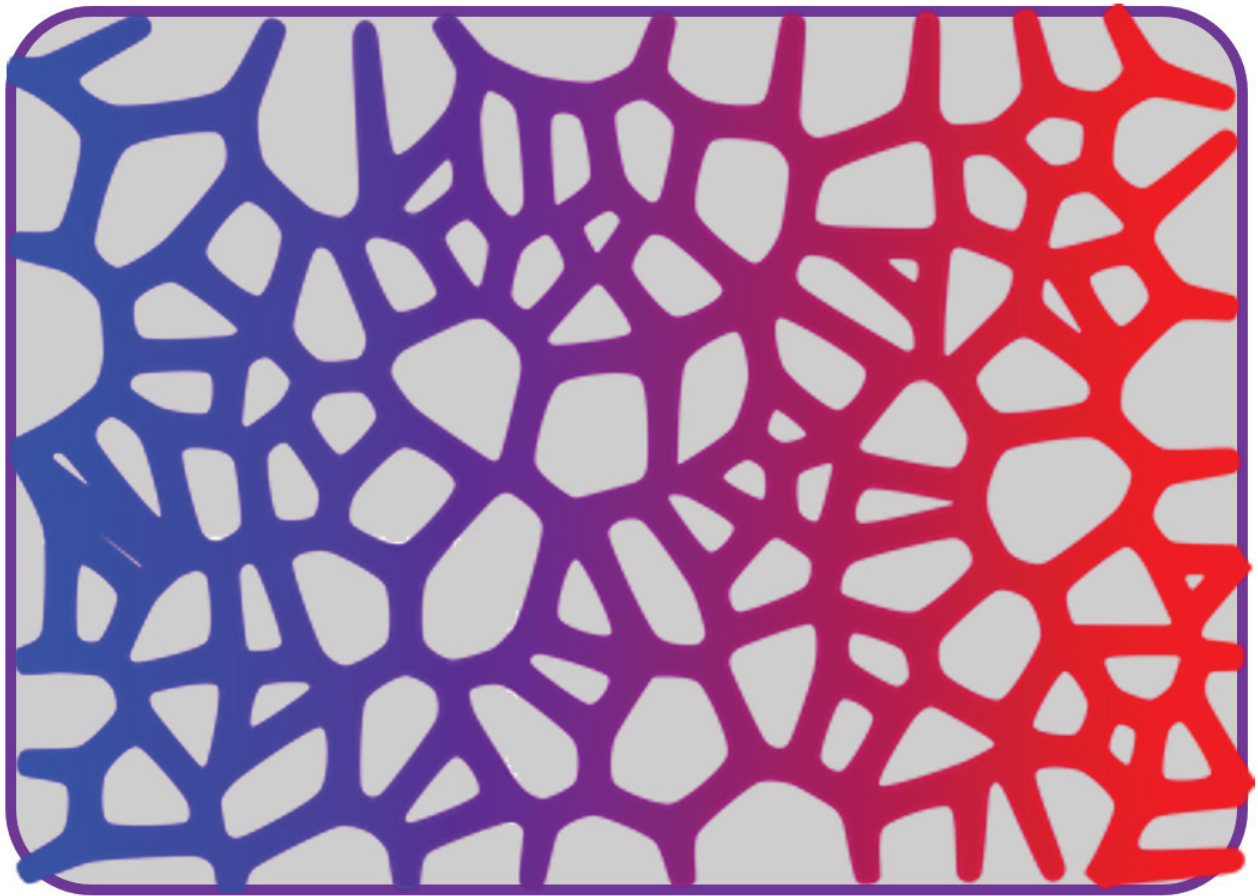
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University of Kent, Canterbury

10–15 July 2022



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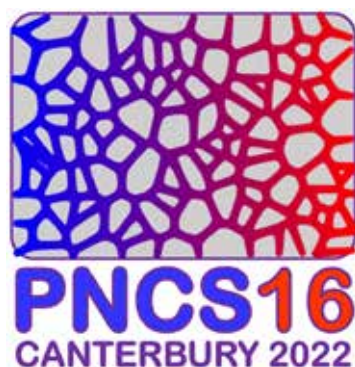
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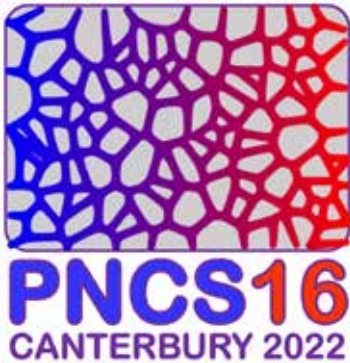


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Silver photochemical reactivity under electronic irradiation analysis of gallo-phosphate glasses

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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 development of innovative materials suitable for integrated circuits as well as laser processing facility are of crucial importance. Indeed, the ability to use direct 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 femto-second laser writing⁽¹⁾ However, the understanding of the photochemical phenomena allowing the formation of the silver clusters, which are at the origin of the fluorescence in the Gallo-phosphate glass remains unclear. Indeed, femtosecond laser interaction with glass creates highly out-of-equilibrium free electrons that allow for the activation of silver-based photo-chemistry and associated local material modifications at the root of high optical contrasts both for linear and nonlinear optical properties. In this framework, it is highly interesting to perform high-energy ionizing irradiation to access 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 performed electronic irradiations followed by EPR spectroscopy. This allowed us to demonstrate the process involved in the interaction of electron beam with both the silver-containing and silver-free glass matrices. This allowed understanding the initial phenomena of electron deposition and charge trapping that support the photosensitivity of these glasses by identifying the point defects and the Ag species, which are formed. The in-situ cathodoluminescence measurements gives additional valuable information about the cascade of chemical reactions in the formation of new silver species, namely from the initial silver ions to the molecular silver clusters.

1. Guérineau, T., Loi, L., Petit, Y., Danto, S., Canioni, L. & Cardinal, T. Structural influence on the femtosecond laser ability to create fluorescent patterns in silver-containing sodium-gallium phosphate glasses. *Opt. Mater. Expr.*, 2018, **8**(12), 3748–3760.
2. Guérineau, T., Cova, F., Petit, Y., Abou Khalil, A., Fargues, A., Dussauze, M., Danto, S., Vedda, A., Canioni, L. & Cardinal, T. Silver centers luminescence in phosphate glasses subjected to X-Rays or combined X-rays and femtosecond laser exposure. *Int. J. Appl. Glass Sci.*, .