Femtosecond Laser Processing of Chalcogenide Glass Thin Films

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Chalcogenide materials are the type of phase changing materials which are immensely used in various optoelectronic applications, sensors and photonic devices [1]. Their wide transparency, high refractive index, tunable bandgap, and exceptional nonlinear response make them truly promising for next-gen photonics [2-3]. The nanostructuring of Chalcogenide thin films can further improve the performance of the material in various applications [4]. Traditional approaches to nanostructuring Chalcogenide glasses often rely on non-laser methods. Also, the nanostructuring of Chalcogenide thin films using femtosecond laser is a less explored area. This study investigates the use of femtosecond laser processing as a potentially more efficient, precise, and versatile technique for fabricating nanostructures on Chalcogenide glass thin films. In this work we have processed the $Ge_{10}Sb_{20}Se_{70}$ Chalcogenide glass thin film having a thickness of 670 nm using femtosecond laser and generated nanoscale ripple structures on the surface.

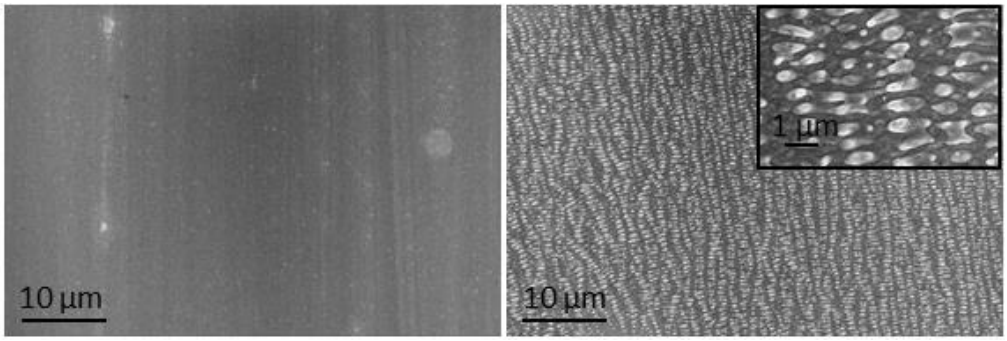

Figure 1. FESEM images of the unprocessed(left) and processed(right) Chalcogenide surface. Magnified image is shown inset.

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References:
[1] Eggleton, Benjamin J., Barry Luther-Davies, and Kathleen Richardson. "Chalcogenide photonics." Nature photonics 5.3 (2011): 141-148.
[2] Lin, Changgui, Christian Rüssel, and Shixun Dai. "Chalcogenide glass-ceramics: Functional design and crystallization mechanism." Progress in Materials Science 93 (2018): 1-44.
[3] Guo, Panpan, et al. "Thermal annealing of Ge-Se thin films and its influence on waveguide performance." Optical Materials Express 10.1 (2020): 129-137.
[4] Shalit, Sivan Tzadka, et al. "Direct nanoimprint of chalcogenide glasses with optical functionalities via solvent-based surface softening." Optics Express 30.15 (2022):26229-26237.