Photorefractive Properties and Laser Nanopatterning of 2D Crystalline As_2S_3

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Crystalline arsenic trisulfide (As_2S_3) is a promising material in nanophotonics due to its high refractive index (>3) and significant in-plane optical anisotropy ($\Delta n \approx 0.4$) [1]. While the amorphous form of As_2S_3 has been extensively studied for photorefractive applications [2], its crystalline counterpart remains underexplored, mainly due to nanostructuring challenges. In this study, we confirm the photorefractive effect in crystalline As_2S_3 and introduce a low-cost, facile continuous-wave (CW) laser-based nanostructuring technique. The analyzed As_2S_3 flakes showed a clear photorefractive response across UV to NIR spectral ranges, highlighting their potential for light-induced tuning of optical properties. Atomic force microscopy analysis further revealed that illumination led to a reduction in flakes' thickness, demonstrating an additional mechanism for controlling their properties using light. The laser patterning achieved high-resolution structures, and optical transmission spectra revealed waveguide modes corresponding to the patterned gratings. This accessible CW-laser-based nanostructuring method simplifies the fabrication of precise nanostructures and offers a cost-effective alternative to femtosecond laser techniques. These findings highlight the potential of crystalline As_2S_3 as a versatile material for future photonic and optoelectronic technologies.

References

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