Ultrafast charge dynamics in two dimensional materials

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Most recently, increasing research efforts on 2D layered materials (2DLMs) are directed toward the nonlinear optical properties, which are not only fascinating from the fundamental science point of view but also intriguing for various potential applications [1]. 2D nanomaterials are emerging as a promising platform for ultra short pulse laser technology and optical switching. Layered two-dimensional transition metal chalcogenides have attracted incredible interest due to their intriguing electronic, electrical, and optical properties [2, 3]. Herein Liquid phase exfoliation (LPE) technique has been employed for the synthesis of ultrathin tin sulfide (SnS) sheets. A many body process, exciton-exciton annihilation was uncovered in such anisotropic nanosheets of reduced dimensionality using pump-probe transient absorption (TA) spectroscopy. Figure 1(a) shows TA spectra of SnS nanosheets at 10 ps time delay where two induced absorption band can be seen at different intensities which could be due to biexciton formation. Furthermore, femtosecond Z-scan measurement revealed, saturable absorption property shown in (Fig.1b) in this material which could be due to optical transitions, which result in band filling from low to high energy band. The value of non-linear absorption coefficient was found greater and saturation intensity was found lower than that of other 2D materials. By taking the advantage of high nonlinear absorption coefficient and low saturation intensity ultrathin SnS nanosheets may prove to be a suitable material for various applications like saturable absorber in Q-switching.

References

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Figures

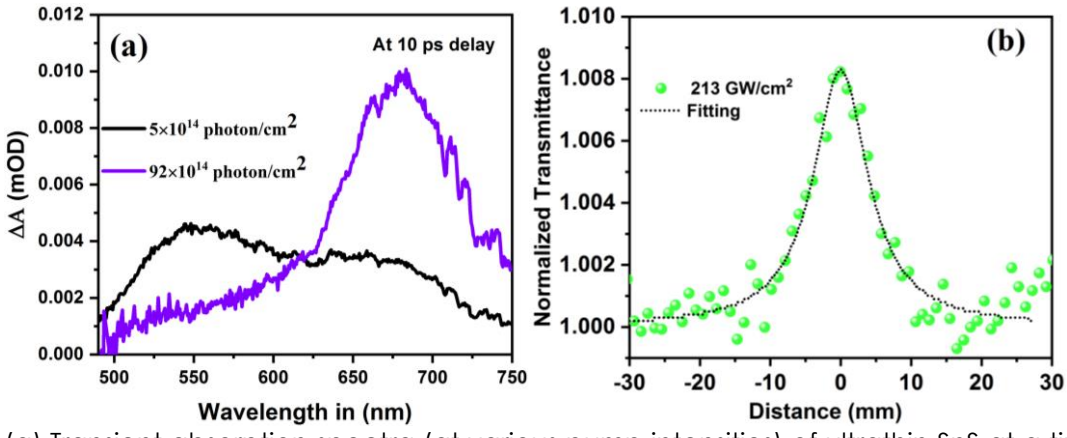

Figure 1: (a) Transient absorption spectra (at various pump intensities) of ultrathin SnS at a time delay of 10 ps. (b) Saturabale absorption response of SnS nanosheets.