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Excitation Density and Energy Dependent Relaxation Dynamics of Charge Carriers in Large Area 2D TMDCs

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Abstract : Transition metal dichalcogenides (TMDCs) are an emerging paradigm for the generation of advanced materials which are capable of utilizing in future device applications. In recent years TMDCs have attracted researchers for their unique band structure in monolayers. Large-area monolayers could become the most appropriate candidate for flexible and thin optoelectronic devices. For this purpose, it is crucial to understand the generation and transport of charge carriers in low dimensions. A deep understanding of photo-generated hot charges and trapped charges is essential to improve the performance of optoelectronic devices. Carrier trapping by the defect states that are introduced during the growth process of the monolayer could influence the dynamical behaviour of charge carriers. Herein, we investigated some aspects of the ultrafast evolution of the initially generated hot carriers and trapped charges in large-area monolayer WS_2 by measuring transient absorption at energies above and below the band gap energy. Our excitation density and energy-dependent measurements reveal the trapping of the initially generated charge carrier. Our results could be beneficial for the development of TMDC-based optoelectronic devices.

Keywords : transient absorption, optoelectronics, 2D materials, TMDCs, exciton
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