Mapping nonlinear optical susceptibility of exfoliated monolayer WS2 with fast spatially resolved noise measurement

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Nonlinear optical (NLO) properties of transition metal dichalcogenides (TMDs) are the subject of extensive research, their inherent lack of inversion symmetry confers them a strong second-order NLO response, making them highly promising for applications in nonlinear photonics [1]. However, how defects alter this nonlinear property and how is their respective NLO response to light are not well understood at nanometer scales [2]. Our group has demonstrated measurements of the optically induced polarization in 2D $MoSe_2$ by force detection using time-resolved AFM (tr-AFM), with the capability to resolve second-order nonlinear susceptibility $\chi(2)$ of a spatial resolution of ~10 nm [3,4]. However, spatially mapping the defect-induced $\chi(2)$ signal remains difficult because of the long time scale of the autocorrelation measurements we employed. We are now aiming to extract the $\chi(2)$ value from the noise in frequency shift signal at the center of autocorrelation, and using it to locate defects that are second-order NLO responsive on exfoliated monolayer WS_2.

Reference

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