Third-order Nonlinearity of MoS$_2$ and WS$_2$ atomic Layers\textsuperscript{1}

TIKARAM NEUPANE, SHENG YU, BAGHER TABIBI, FELIX JAETAE SEO, Hampton University — The third-order optical nonlinearity of 2D transition metal dichalcogenide atomic layers is of great interest for the prospective applications in optical modulators and photonic devices. The third-order nonlinearity includes the nonlinear absorption and nonlinear refraction which can be characterized through either resonant or non-resonant excitation. The atomic layers for this presentation include tungsten disulfide (WS$_2$) and molybdenum disulfide (MoS$_2$) nanoflakes of 1-4 layers in deionized water. The excitation wavelength was 532 nm which was located above A and B exciton absorptions of MoS$_2$ and between A and B exciton spectra of WS$_2$. The excitation at 2.33 eV is resonant for A and B excitons of MoS$_2$ and A exciton of WS$_2$, and the non-resonant for B exciton of WS$_2$. The nonlinear absorption coefficients for WS$_2$ and MoS$_2$ nanoflakes were analyzed to be $\sim 6.7 \times 10^4$ cm/GW and $\sim -1.0 \times 10^5$ cm/GW with open Z-scan, respectively. The nonlinear refraction of WS$_2$ and MoS$_2$ were estimated to be $\sim -6.7 \times 10^{-10}$ cm$^2$/W and $\sim -1.3 \times 10^{-10}$ cm$^2$/W, respectively, with peak-valley nonlinear transmittance trace.

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