Characterization of the nonlinear optical susceptibilities of monolayer MoS$_2$ and comparison with graphene

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Abstract
We report the determination of the second and, for the first time, third order optical nonlinear susceptibilities of monolayer MoS$_2$ by measurements of second and third harmonic generation [1]. The measurements were made using a nonlinear optical microscope (Figure 1) with a 1560 nm wavelength (non-resonant) pump beam. The experimental system also enables high resolution third harmonic imaging. The measured susceptibilities, inferred from the dependence of third harmonic intensity on pump beam intensity and interpreted as sheet susceptibilities [2] are:

$$\chi^{(2)}_s = 2 \times 10^{-20} m^2 V^{-1}$$ and
$$\chi^{(3)}_s = 1.7 \times 10^{-28} m^3 V^{-2}$$

The third order susceptibility of graphene was determined, using the same experimental setup, to be approximately 3.4 times lower than that of MoS$_2$ (Figure 2). The results highlight the potential of MoS$_2$ for low footprint nonlinear optical devices in the telecommunications C-band.

References

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