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Role of precursors' ratio for growth of two-dimensional MoS_2 structure and investigation on its nonlinear optical properties

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Abstract

In this study, thin films containing mono and few-layer MoS_2 were directly synthesized by one-step thermal chemical vapor deposition on Si/SiO_2 substrate. The effects of precursors' ratios including sulfur and MoO_3 powders were systematically studied by altering sulfur content for the growth of MoS_2 nanoflakes. The X-Ray diffraction patterns and scanning electron microscopy confirmed the formation of MoS_2 nanoflakes in sulfur contents of 500 and 1000 mg. According to the line width and frequency difference between the E^1_{2g} and A_{1g} in Raman spectroscopy, the nanoflakes grown with sulfur content of 500 and 1000 mg were two-dimensional MoS_2 structures having few numbers of layers. Moreover, it was verified by assessment of the nanoflakes' band gap via UV-visible and photoluminescence analysis. In addition, the open-aperture and close-aperture Z-scan techniques were employed to study the nonlinear optical properties including nonlinear absorption and nonlinear refraction of the synthesized nanoflake in sulfur content of 500 mg. The experiments were performed using a diode laser with a wavelength of 532 nm as light source at different powers. The nanoflakes displayed considerable saturable absorption (SA) under low laser power and reverse saturable absorption (RSA) at higher laser powers. In