Thickness-Dependent Raman and Photoluminescence Spectra of 2D Indium Selenide

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Recently, III–VI group layered two-dimensional (2D) semiconductors, such as GaS, GaSe, InSe, have considered as promising potential materials for next-generation optoelectronic devices, due to their variable bandgap, high electron mobility, wide photoluminescence (PL) response and ohmic contact [1-3].
In this work, samples of layered indium selenide were synthesized by fusing the corresponding stoichiometric compositions in a vacuum and then thinned down to a nanometer thickness using micromechanical exfoliation. Obtained thin flakes of InSe were placed on SiO_2/Si substrates and studied using atomic-force microscopy and Raman spectroscopy. It was found out that the decrease of the thickness down to 4 nm leads to the rise of an additional peak at ~200 cm^{-1} in Raman spectrum, which is explained by mechanical stress or by the stronger light absorption of thinner InSe flakes.

Photoluminescence studies were performed using Raman spectrometer and 473 nm excitation laser. There was revealed a strong dependence of the intensity of PL peak at 510 nm (2.43 eV) on the thickness of the InSe flake. However, single- and bi-layered samples demonstrate neither Raman nor PL signal, possibly due to the fast oxidation without protective coating.

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