Optical Properties of Defects in Exfoliated MoS_2 Measured by Reflectometry and Raman Scattering

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Scotch tape exfoliation is a widely used technique of obtaining two-dimensional crystals from bulk materials of layered structure like graphite or transition metal dichalcogenides (TMDCs). A typical representative of the TMDC family is molybdenum disulphide (MoS_2), a naturally occurring mineral, whose structure is characterized by strong intralayerion-covalent bonds between sulphur and molybdenum atoms and by weak van der Waals bonds between S-Mo-S layers.

A confocal microscope was used for scanning the surface of MoS_2 samples and for studying different defects formed during the exfoliation process. The measurements were carried out at room temperature with the aid of red (633 nm) and green (532 nm) laser light illumination. Our experimental setup enabled us to obtain images with a spatial resolution up to about 300 nm(see Figure). Different light sources allowed for highlighting different defects as: folding, cracking, or displacement, whose visibility turned out to be wavelength-dependent. The reflectivity of MoS_2 flakes was compared with the Raman spectroscopy measurements used for sample's thickness estimation. We demonstrate that the correlation between the number of layers in a flake and the intensity of light reflected from the flake can be used for preliminary determination of the flake's thickness.

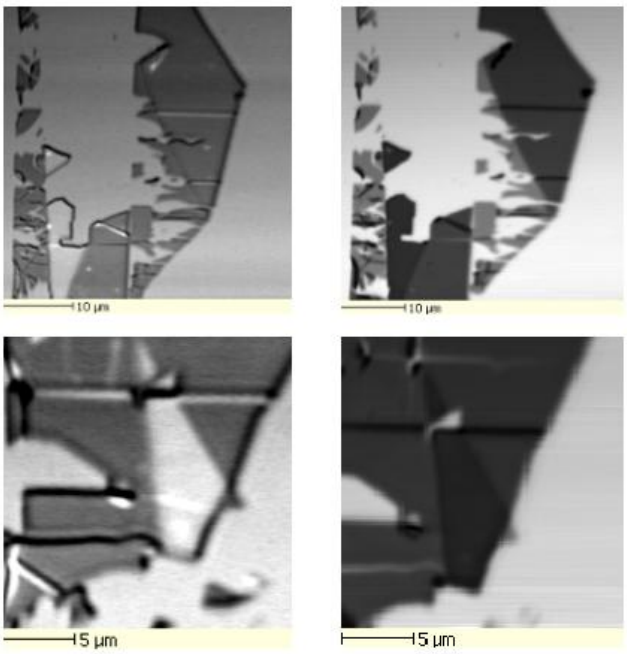

Figure. Microscopic images of exfoliated MoS2 illuminated by red (left) and green (right) laser. Different defects are determined: folding, cracking, displacement. The thickness of these defects was determined by Raman spectroscopy.