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Influence of Oxalic Acid Concentrations on the Growth of Molybdenum Disulphide.

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Single source precursor (SSP) was commonly used as the starting material for the wet chemical process of molybdenum disulfide (MoS_2). Due to the imbalanced stoichiometry ratio of the required contents, much higher thermal energy are needed to synthesize crystallite MoS_2 from the SSP. While dual source precursors (DSP) approach using two separated Mo and S source precursors to synthesize MoS_2. This technique is more cost effective and flexible control over the stoichiometry of the required contents as compared to that of the SSP technique. In this work, DSP approach was used to synthesize the MoS_2 and the effects of the oxalic acid concentrations (i.e., 2 M, 6 M and 10 M; molar, M) on the growth of MoS_2 were investigated. The properties of the deposited films were investigated by means of atomic force microscopy (AFM), Raman spectroscopy, and ultra-violet visible (UV-Vis) spectroscopy. The AFM surface topography shows the improved homogeneity and higher compactness films with the increasing of the acid concentration from 2M to 6M. However, higher concentration favoured in inhomogeneous grains and higher void formations. Apart from that, two distinct Raman phonon modes of the MoS_2 at around 383cm^{-1} (E_{2g}) and 408cm^{-1} (A_{1g}) can be detected in all the deposited films, except for 2M acid concentration where E_{2g} is not detected. Once again, the 6M acid concentration can produce MoS_2 with sharpest and lowest value of FWHM for the E_{2g} and A_{1g} peaks. The higher intensity of Raman peaks implies that the deposited film has large lateral grain size. From the fitting of the Raman spectra for samples produced with 6M and 10M acid concentrations, the frequency difference (Δk) between E_{2g} and A_{1g} value is around 25cm^{-1}. This results reveal that the synthesized MoS_2 films consisted of multi-layers. The UV-Vis specular reflectance results also reveal that crystallite MoS_2 films can be formed by using precursor with 6M oxalic acid concentration. The direct transition exciton energies of the MoS_2 were respectively detected at 611 nm and 660 nm. Through the investigation on the effects of the acid concentrations on the growth of MoS_2, it can be concluded that precursor with 6M acid concentration was the suitable condition for synthesizing crystallite MoS_2.

Keywords: Molybdenum disulfide, oxalic acid, sulfurization, spin coating, Raman spectra, UV-Vis specular reflectance.