INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.
Thesis Title	:	Structural and Optical Characterization of Pulsed Laser Deposited MoS_2 and WS_2 Layered Thin Films and Quantum Dots
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SHORT ABSTRACT

The aim of the thesis is to synthesize monolayer to multilayered MoS_2 and WS_2 thin films and quantum dots (QDs) by pulsed laser deposition and pulsed laser ablation in liquid and to use the as-synthesized thin films and quantum dots sample as an efficient catalyst for hydrogen generation. Mono- and a few layered MoS_2 films were deposited with finely controlled by applying different numbers of laser pulses. A similar experiment was also performed to synthesize monolayer to multilayered WS_2 thin films where the laser fluence was varied and other deposition parameters were kept constant. An efficient way to deposit 1T and 2H mixed-phase mono and a few layered MoS_2 thin films in a very short span of time of 20 sec was achieved in a single step bottom-up growth process. The films showed a mixed-phase structure while the 2H to 1T phase ratio increased from 66 to 84% with an increase in the deposition temperature from 400 to 720 °C. An experimental investigation was carried out to identify the scaling behavior as well as the growth mechanism of 2D MoS_2 thin films grown by pulsed laser deposition at different deposition time durations, using atomic force microscopy images. The growth of MoS_2 thin films followed intrinsic anomalous scaling behavior. Similar work was also extended to WS_2 films deposited on to corning glass and SiO_2/Si substrate as well. A significantly large reverse saturation absorption and positive nonlinear refraction response were observed in all the MoS_2 and WS_2 films deposited at various argon pressure, as measured by the open and closed aperture Z-scan experiment under He-Ne laser at 632.8 nm. The anomalously high nonlinear optical response of the film was attributed to the continuous-wave laser-induced thermal nonlinearity dominance over optical nonlinearity. Optical limiting was also observed in the WS_2 thin films. Along with layered thin films, MoS_2 and WS_2 QDs were also synthesized by multilevel photo-exfoliation of solid MoS_2 target using pulsed laser ablation in distilled water. As an application, MoS_2 and WS_2 films of various thicknesses and MoS_2 QDs of various sizes were used as a catalyst for hydrogen evolution reaction.