



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Larionette P. L. Mawlong

Roll Number : 136153008

Programme of Study : Ph.D.

Thesis Title: Study on Controlled CVD Growth of Monolayer MoS₂ and its Heterostructures for Optoelectronic Applications

Name of Thesis Supervisor(s) : Prof. P. K. Giri

Thesis Submitted to the Department/ Center : Nanotechnology

Date of completion of Thesis Viva-Voce Exam : 06-11-2020

Key words for description of Thesis Work : CVD, Photoluminescence, Photodetection, Photoresponse

SHORT ABSTRACT

My PhD thesis focuses on the controlled growth of monolayer MoS₂ and MoS₂ based heterostructure with other 2D material (WS₂), TiO₂ nanostructures and plasmonic nanoparticles (Ag, Au). These heterostructures are synthesized by various methods including chemical vapour deposition (CVD), RF sputtering and hydrothermal method. We have studied the controlled large area growth of monolayer MoS₂ by CVD technique on a variety of different substrates. We have successfully fabricated large area high quality p-n heterojunction between single layer MoS₂ (1L- MoS₂) and TiO₂ nanorods, grown by in-situ CVD technique showing strong enhancement of PL intensity mediated by the charge transfer due to the p-doping effect in 1L-MoS₂. We have also fabricated TiO₂ /Au/MoS₂ (TiO₂ /Ag/MoS₂) ternary core-shell heterostructure with an array of Au/Ag nanoparticles (NPs) coated on the hydrothermally grown hierarchical TiO₂ nanostructures followed by a direct CVD growth of monolayer MoS₂ and studied the effect of the plasmonic NPs on the ternary system, thus, causing a giant enhancement in the PL intensity. We studied the tunability of the photoluminescence (PL) of the monolayer MoS₂ (1L-MoS₂) by decorating it with WS₂ quantum dots (WS₂ QD) by solving the four-energy level model involving coupled carrier dynamics based on the coupled rate equations. We have also developed 1L-MoS₂/WS₂ QD heterojunction photodetector demonstrating ultrafast and broadband high photodetection.