Defect Quantification of Metal Organic Chemical Vapor Deposition (MOCVD) Monolayer Molybdenum Disulphide (MoS$_2$) using Kelvin Probe Force Microscopy

Moha Feroz Hossen$^1$, Sachin Shendokar$^1$, Swapnil Nalawade$^1$, Olubukola Ayanbajo$^1$, Kyle Nowlin$^1$, and Shyam Aravamudhan$^1$

$^1$North Carolina Agricultural and Technical State University

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Abstract

Defects are unavoidable during the synthesis of materials due to thermodynamic equilibrium. In the synthesis of two-dimensional transition metal dichalcogenide (2D TMDC), point defects emerge as a dominant defect due to the absence of chalcogen atoms in the lattice structure. In one or a few layers of TMDC materials, the presence of defect states on the film surface changes their carrier concentration. The changing of carrier concentration in monolayer TMDC film shifts the position of the fermi level towards either conduction band edge or valence band edge depending on the type of majority carriers. The shifting of the fermi level changes the work function of the TMDC monolayer film. The conventional hall measurement is not feasible to measure the surface carrier concentration of 2D materials films. Instead, kelvin probe force microscopy (KPFM) is used to measure surface carrier density. The carrier density is calculated by measuring the work function of the monolayer film using KPFM. Each point defect in 2D TMDC materials increases the certain amount of carrier concentration that facilitates the defect quantification. In this work, we tried to quantify point defect in metal-organic chemical vapor deposition (MOCVD) monolayer MoS$_2$ using kelvin probe force microscopy (KPFM) by measuring the position of the fermi level that is shifted due to the unbounded electrons of MoS$_2$.

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