

Growth of high quality AlN films on 2D TMDc for next-generation electronic and optical devices applications

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Recently, 2D materials such as TMD is for next generation semiconductor applications. Also, it is suitable to as a buffer layer for high quality III-nitride on Si device system, due to van der Waals epitaxy growth. van der Waals epitaxy (VDWE) is an ideal method for growing 2D materials and topological insulators (TIs) onto a variety of substrates for heterostructure and integrated circuit technologies. In our study, we demonstrated that high quality hexagonal AlN thin films were grown on transition metal dichalcogenide (TMD) layers such as WS₂ via van der Waals epitaxy by radio-frequency metalorganic molecular beam epitaxy (RF-MOMBE). The growth parameters such as N₂/TMAI flux, RF power and substrate temperature to affect the crystallographic and morphological properties of AlN layers, which were evaluated using in-plane X-ray diffraction (IP-XRD) analysis, field emission scanning electron microscopy (FE-SEM) and Raman spectrum. XRD profile indicated that the AlN thin films exhibited highly preferred orientation along the <0001> direction with WS₂/Al₂O₃ substrate. Also, Phi-scan pattern shows The AlN film is in epitaxy with WS₂/Al₂O₃ substrate with orientation relationships of AlN(10-10)//WS₂(10-10)//Al₂O₃(11-20). XRC results demonstrated that the crystals qualities of AlN films improved with increase in RF power. SEM images show the smooth surface with a RF power at 300 W.

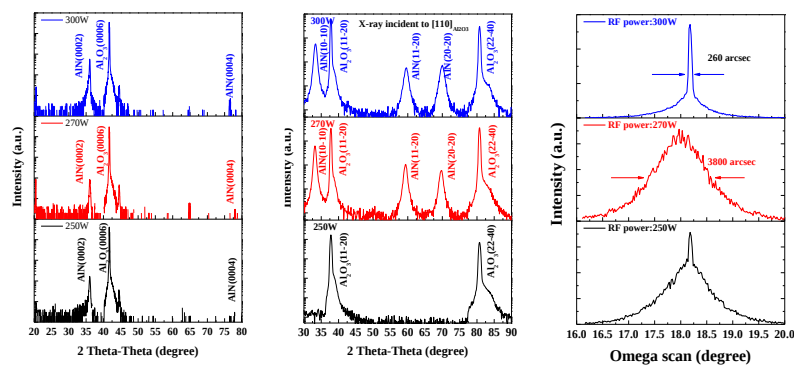


Figure 1. XRD pattern of AlN/WS₂/Al₂O₃

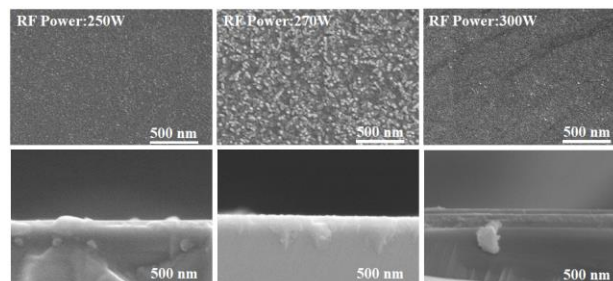


Figure 2. SEM micrograph of AlN/WS₂/Al₂O₃ with various conditions.