

# 2D Materials Based van der Waals Heterostructures by Pulsed Laser Deposition (PLD)

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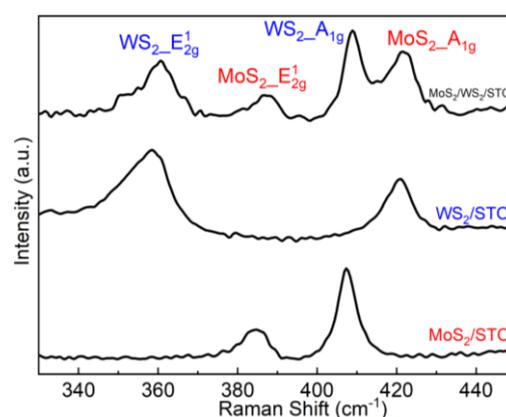
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Since the discovery of Graphene, atomically thin semiconductor 2D materials and their van der Waals heterostructures have attracted a lot of interest for electronic and optoelectronic devices [1, 2]. For the growth of 2D materials and heterostructures, Pulsed laser Deposition (PLD) has emerged recently as a suitable growth technique. It allows a homogeneous deposition on the substrate on the cm<sup>2</sup> scale, an efficient control of the number of layers, and stoichiometric transfer of the target material during the growth [3, 4]. In present study, we will discuss the deposition conditions and characterizations of individual layers of WS<sub>2</sub> and MoS<sub>2</sub> grown on sapphire and STO substrate by PLD. The presence of two prominent Raman modes  $E_{2g}^1$  which appear at ~359 cm<sup>-1</sup> for WS<sub>2</sub> and ~386 cm<sup>-1</sup> for MoS<sub>2</sub> due to in plane vibration and  $A_{1g}$  mode which appears ~421 cm<sup>-1</sup> and ~407 cm<sup>-1</sup> for WS<sub>2</sub> and MoS<sub>2</sub> respectively due to out of plane vibration mode confirm the formation of 2D materials on those substrates [5]. The transport study confirms that MoS<sub>2</sub> exhibits p-type and WS<sub>2</sub> show n-type behavior. Finally, PLD grown 2D van der Waals heterojunctions are grown by successive stacking of p-type MoS<sub>2</sub> and n-type WS<sub>2</sub> layers [6]. The presence of Raman modes obtained on the p-n heterojunctions on sapphire and STO substrates confirms the success of the growth (as shown on figure 1). A detail analysis of PLD grown p-n heterojunctions with different MoS<sub>2</sub> and WS<sub>2</sub> layers will be presented and discussed.

## References

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## Figure



**Figure 1:** Raman Spectra of the heterostructures (MoS<sub>2</sub>/WS<sub>2</sub>/STO) and individual layers of MoS<sub>2</sub> and WS<sub>2</sub> grown on STO substrate