Surface Treatment in Molybdenum Disulfide Atomic Layer Deposition for Next-generation Channel Materials

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Abstract

Transition metal dichalcogenide (TMDCs) compound with a two-dimensional (2D) layer structure have been extensively studied due to their potential applications in semiconductor devices. [1] One of MoS_2 synthesis method is chemical vapor deposition (CVD). It has the disadvantage of high process temperature and low step coverage. [2] In this regard, atomic layer deposition (ALD) would be a suitable deposition process for demonstrating excellent step-coverage, low temperature process. One of the issues of conventional ALD method is small lateral grain size, which causes significant mobility degradation. [3] In this study, we used ethanol as a surface treatment agent during the MoS_2 ALD process to increase the crystallinity of MoS_2. During the MoS_2 deposition process, $Mo(CO)_6$ reacting with DEDS to sulfurization, the state of Mo oxidation was changed according to surface treatment. Various ALD sequences consisted of Mo precursor feeding, sulfurization agent feeding, and ethanol feeding were examined to elucidate the mechanism of MoS_2 formation involving the effect of ethanol including Raman analyses (Figure 1). Furthermore, the characteristics of bottom gate thin-film transistors (TFTs) depending on the surface treatment were examined.

References

[1]   D. H. Kim et al., Chem. Mater, 33 (2021) 4099 [1]
[2]   Wang. S et al, Chem. Mater, 22 (2014) 6371 [2]
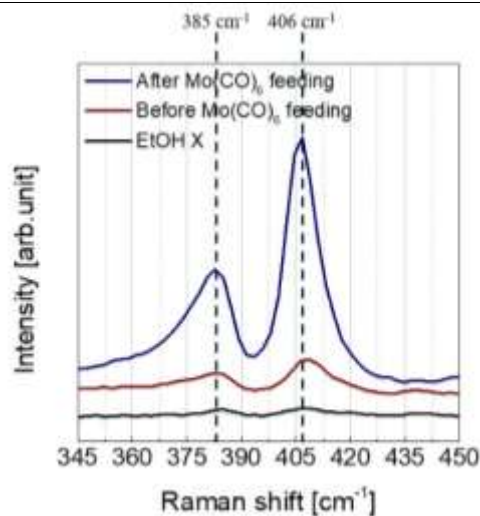[3]   W. Jeon et al, Adv. Mater, 47 (2017) 1703031 [3]

Figures

Figure 1: MoS_2 Raman analysis results according to surface treatment.