Growth of c-axis textured AlN PVD film on a $2D$-MoS_2 seed layer: Supplemental document

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1) Rocking Curve Measurement

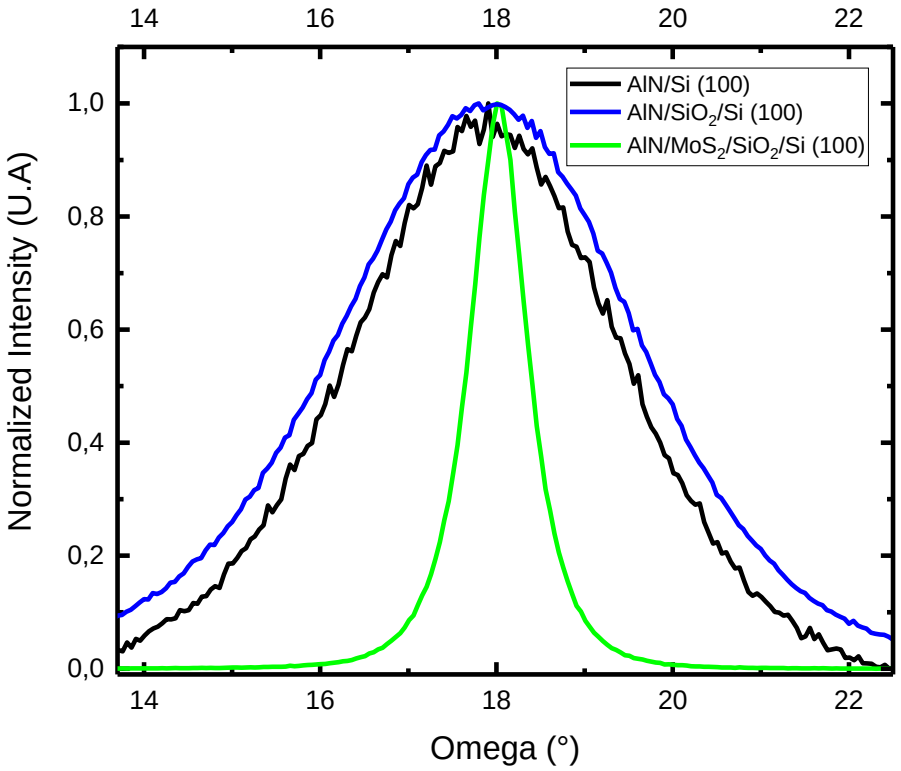

Figure 1: Comparison of AlN (002) Rocking Curve grown by PVD on different substrates.

A rocking curve (RC) measurement, also called omega scan, is a XRD analysis enabling the evaluation of the crystal mosaicity (misorientations of crystal domains with respect to one another).

RC on AlN/Si (100) ≈ 3,8°

RC on AlN/SiO_2/Si (100) ≈ 4,0°

RC on AlN/MoS_2/SiO_2/Si (100) ≈ 0,5°

2) Opening to other AlN deposits on MoS_2/AlN stacks

New investigations using additionnal MetalOrganic Chemical Vapor Depostion (MOCVD) step are also on going. The results are promising and lead to better AlN crystalline quality compared to pure AlN PVD deposit. In addition Scandium (Sc) doped AlN thin films investigations are also in progress. In fact, Sc is well-known element to enhance the piezoelectric properties of AlN thin films.

3) Abstract references

(1) Aigner, R.; Ella, J.; Timme, H.-J.; Elbrecht, L.; Nessler, W.; Marksteiner, S. Advancement of MEMS into RF-Filter Applications. In *Digest. International Electron Devices Meeting,*; 2002; pp 897–900.

(2) Muralt, P. AlN Thin Film Processing and Basic Properties. In *Piezoelectric MEMS Resonators*; Bhugra, H., Piazza, G., Eds.; Microsystems and Nanosystems; Springer International Publishing: Cham, 2017; pp 3–37.

(3) Kumar, A.; Prasad, M.; Janyani, V.; Yadav, R. P. Optical Characterization of RF Sputtered AlN Thin Film for Acoustic and Optoelectronics Devices. In *2019 9th Annual Information Technology, Electromechanical Engineering and Microelectronics Conference (IEMECON)*; 2019; pp 60–63.

(4) Hsu, W.-F.; Lu, L.-S.; Kuo, P.-C.; Chen, J.-H.; Chueh, W.-C.; Yeh, H.; Kao, H.-L.; Chen, J.-S.; Chang, W.-H. Monolayer MoS_2 Enabled Single-Crystalline Growth of AlN on Si(100) Using Low-Temperature Helicon Sputtering. *ACS Appl. Nano Mater.* **2019**, *2* (4), 1964–1969.

(5) Chien, H.-Y.; Kuo, P.-C.; Kao, H.-L.; Chen, J.-S.; Chen, M.-R.; Lu, L.-S.; Chueh, W.-C.; Chang, W.-H. Low Temperature Deposition of High Quality Single Crystalline AlN Thin Films on Sapphire Using Highly Oriented Monolayer MoS2 as a Buffer Layer. *Journal of Crystal Growth* **2020**, *544*, 125726.

(6) E. R. Braitwaite; J. Haber. Molybdenum, Volume 19: An Outline of Its Chemistry and Uses - 1st Edition. **1994**.

(7) Cadot, S.; Renault, O.; Frégnaux, M.; Rouchon, D.; Nolot, E.; Szeto, K.; Thieuleux, C.; Veyre, L.; Okuno, H.; Martin, F.; Quadrelli, E. A. A Novel 2-Step ALD Route to Ultra-Thin MoS_2 Films on SiO_2 through a Surface Organometallic Intermediate. *Nanoscale* **2017**, *9* (2), 538–546.

(8) Jariwala, D.; Sangwan, V. K.; Lauhon, L. J.; Marks, T. J.; Hersam, M. C. Emerging Device Applications for Semiconducting Two-Dimensional Transition Metal Dichalcogenides. *ACS Nano* **2014**, *8* (2), 1102–1120.

(9) Li, X.; Zhu, H. Two-Dimensional MoS2: Properties, Preparation, and Applications. *Journal of Materiomics* **2015**, *1* (1), 33–44.