(Supplemental)
Atomic Layer Deposition of Nanometer Thick Tungsten Nitride Using Anhydrous Hydrazine for Potential X-Ray Optics Application

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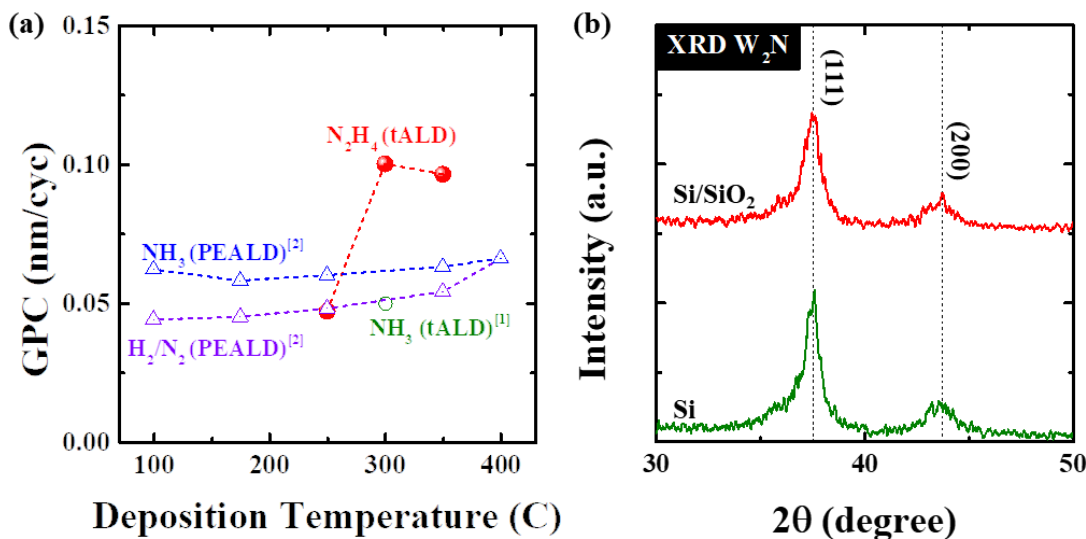

Figure 1. (a) Relationship between the deposition temperature and the GPC of WN_x thin films. In general, PEALD with ammonia allows a higher growth rate comparing to tALD using the same nitrogen source. At 250°C, hydrazine can produce almost the same growth rate as 300-degree process with NH_3. The highest GPC of WN_x is obtained with hydrazine at 300°C. (b) XRD results shows (111) phase and (200) of W_2N films using hydrazine as a precursor on both silicon and silicon oxide wafers.

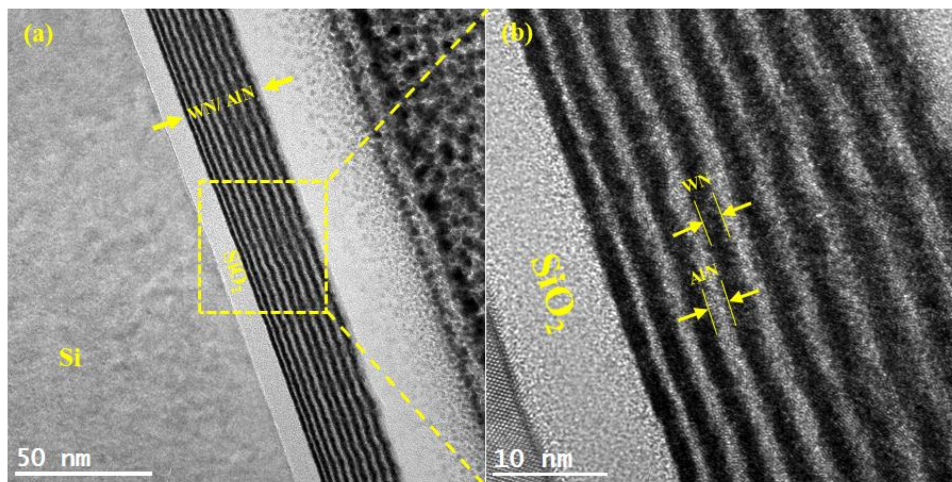

Figure 2. (a) Demonstration of stacking structure of tungsten nitride and aluminum nitride thin films. TEM images confirm layering structure of metals nitride films deposited using hydrazine. (b)There is a total of 18 layers (9 WN layers and 9 AlN layers). We notice that the AlN_x layers have variation in thickness. It is possible that the surface condition of first tungsten nitride layer is not ideal for AlN_x to form easily. However, as the film thickness increases, the thickness of each aluminum nitride layer appears to improve. This metal nitride stack with different densities can be used for X-Ray filter mirror application.

[1] J.S. Becker, et al., Chem. Mater. **15** (15), 2969 (2003).
[2] M.J. Sowa, et al., Jour. Vac. Sci. Tech. A **34** (5), 051516 (2016).