Atomic Layer Deposited Al_20_3 as Characterized Reference Samples for Nanolayer Metrology

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ABSTRACT

The continuous reduction of device dimensions for nano- and microelectronics but also for nanotechnologies drives the development of metrology, analysis and characterization. The comparison and benchmarking of metrology require well-designed calibration and reference materials [1]. Due to the interaction of the probe with the studied sample, and in particular the specific probing conditions at the sample, reference samples have to be adapted to the measurement task. Furthermore, the specific modelling of both the sample and the metrology are required for obtaining comparable and reliable results. In this paper thin Al_2O_3 films produced by Plasma Assisted Atomic layer Deposition (PA ALD) were characterized by a complementary metrology approach using Spectroscopic Ellipsometry (SE) and Total Reflection X- Ray Fluorescence (TXRF).

The instruments were a Woollam M-2000DI rotating compensator ellipsometer and an Atomika 8300 W using WLβ excitation, respectively. SE was used to determine the thickness and the optical properties of the samples. TXRF was used to perform elemental depth profiling and surface contamination analysis. The linearity of the layer thickness with the number of cycles is given in Figure 1 (left). The linearity of the Al fluorescence signal as a function of the number of cycles is given in Figure 1 (right). The Figure 1 (middle) shows the angular resolved TXRF analysis of Al in the layer. Such results require modelling of the according metrology and the samples e.g. the elemental distribution on the surface. Sulphur and chlorine profiles on surface and in the depth were detected and analyzed, too. These characterized samples sustain development of analytical techniques. Furthermore, they are suitable for calibration and benchmarking of optical and X-ray metrology.

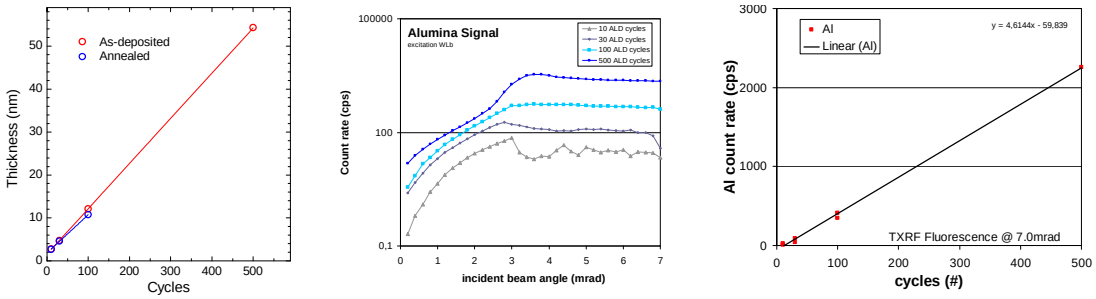

FIGURE 1: left: Results of ellipsometry showing the thickness vs. ALD cycles. The interception with the y axis is 1.61 and 1.86 for the as-deposited and annealed cases, respectively.
middle: TXRF Al signal as a function of the incident beam angle, showing an increase of the critical angle.
right: Result of the TXRF analysis showing the a linear Al signal increase with the number of cycle at 7.0 mrad incident beam angle

REFERENCES

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