Fully automated multi-applications approach in the analysis of material: a case study on heat treatment effects on TiN thin film samples

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In this presentation, by effortlessly combining several X-ray diffraction and scattering techniques on one sample, we show the possibility to characterize more completely the properties of engineered advanced materials.

As an example, two 118 nm thick TiN on Si thin film samples (as deposited vs. heat treated) were investigated using the new MultiCore (iCore and dCore) optics in an Empyrean diffractometer. These new optics are designed for fully automated switch between applications without user intervention, allowing a more efficient utilization of the instrument.

For this study, the following applications were performed: Grazing Incidence X-ray Diffraction (GIXRD) for increased surface sensitivity for phase identification and stress analysis, X-ray Reflectivity (XRR) for layer thickness and roughness, Pole Figure (PF) for texture analysis and to investigate preferred orientation.

The results show that the heat treatment reduces surface roughness and increases crystallite size and absolute residual stress level. From sample alignment to final measurement, Empyrean with MultiCore optics can handle easily all applications without any user intervention. Fully automated data collection simplifies dramatically the routine operation therefore improving the instrument throughput.

Figure 1 Empyrean configuration with iCore, dCore and Chi-phi-x-y-z sample stage. Multiple samples can be mounted for automated measurements

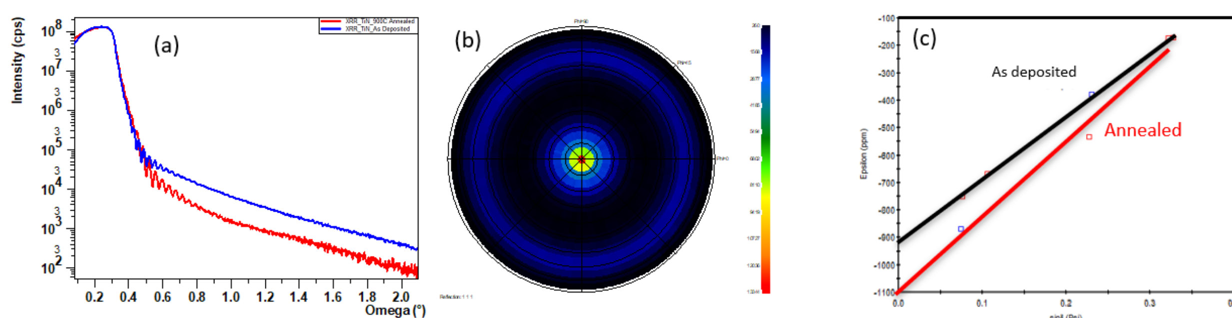

Figure 2 (a) XRR curves of the TiN layer. Red curve represents the sample after annealed at 900°C, the blue curve measured on the as-deposited sample. (b) Pole figure of (111) plane. (c) Residual stess result of the two samples