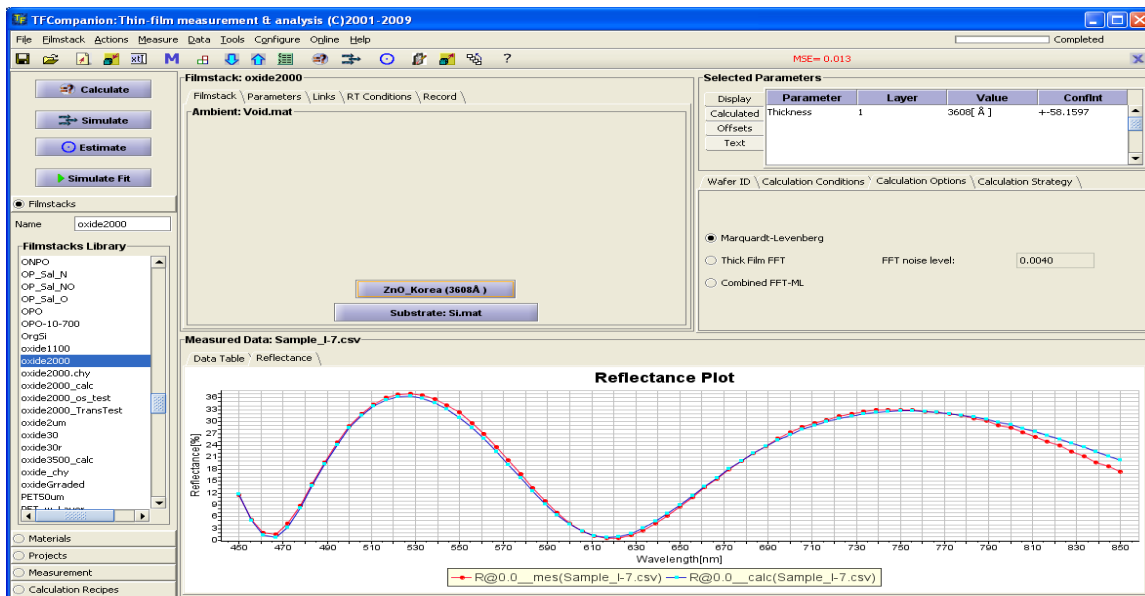# ZnO (AZO) Measurement

Al -doped ZnO is widely used as a TCO (transparent conductive oxide) layer in thin-film solar cells.

Detailed analysis of the AZO optical dispersion, bandgap, etc. can be done using MProbe UVVisSr system that allows measurement down to 200nm. However, ZnO is frequently deposited on glass or metal coating (like Mo) – in both cases data analysis of the measurement in UV becomes challenging because of the absorption (of light scattering) from the substrate.

AZO can be successfully measured using our MProbe Vis system that covers 400-1000nm wavelength range.

In following examples, samples were measured using MProbe Vis system to determine thickness and optical dispersion in the visible range. AZO optical dispersion was represented using CP-Exciton approximation model.

Fig, 1 Sample #1 AZO/Si . Model to measurement fit, T, n,k are determined simultaneously. Thickness: 360nm (See Fig 2 for n,k spectra)
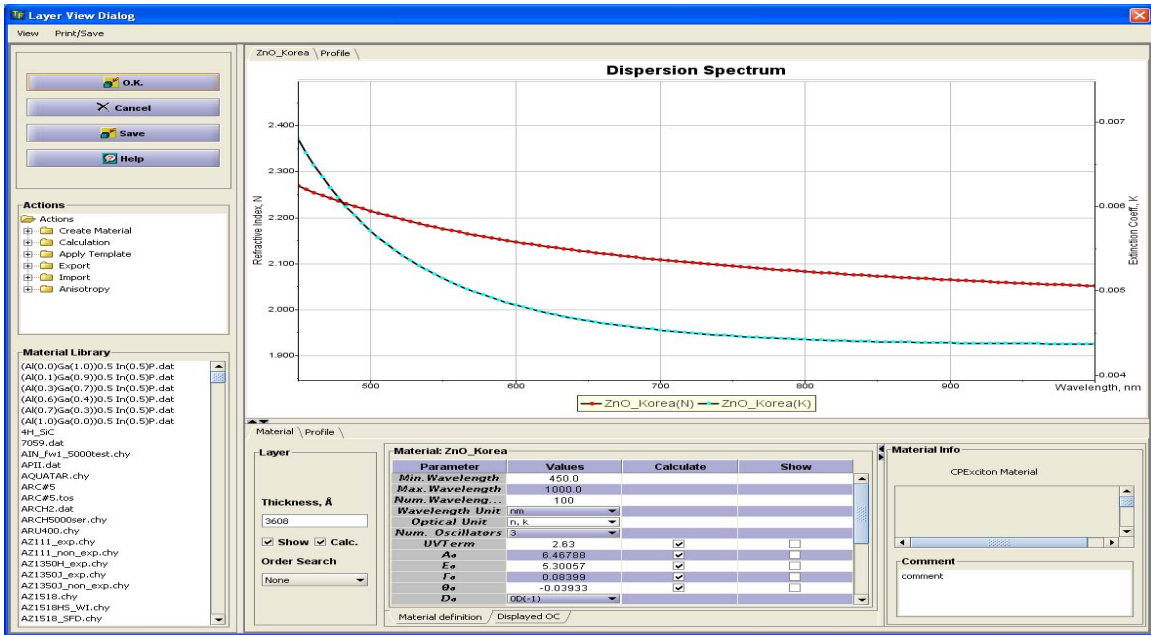
Fig. 2. Sample #1 optical dispersion determined form the measurement.
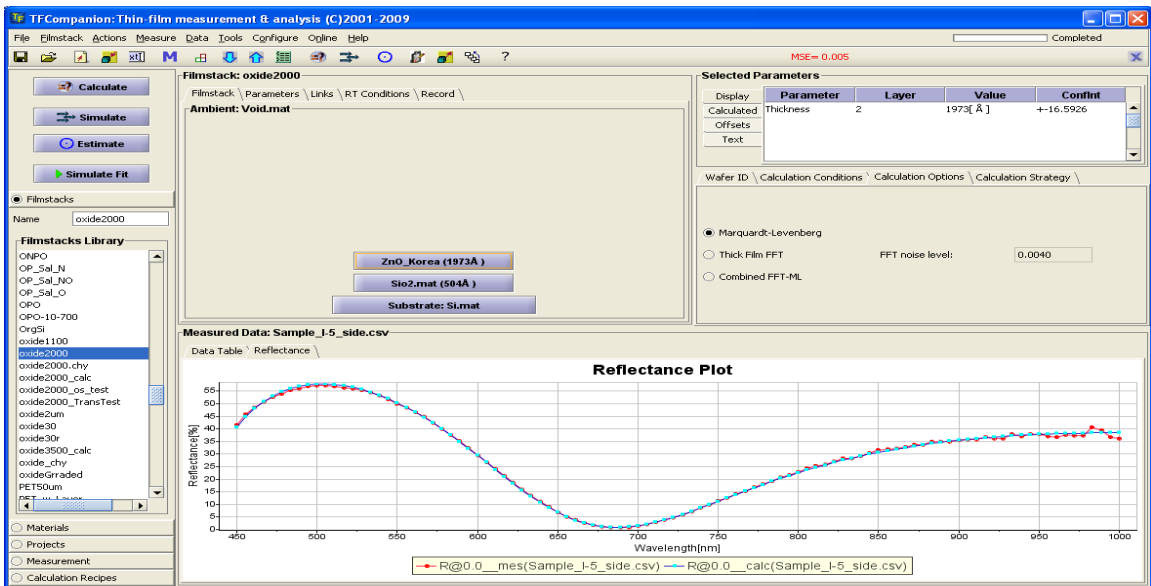

Fig. 3. Sample #2 (AZO/SiO2/Si). Fit of the model to measurement data. Calculated parameters AZO and SiO2 thickness (197nm AZO/50nm SiO2/Si). AZO dispersion from the Sample#1 is used. Good fit to the measured data shows that the optical properties of the AZO in both sample are the same.
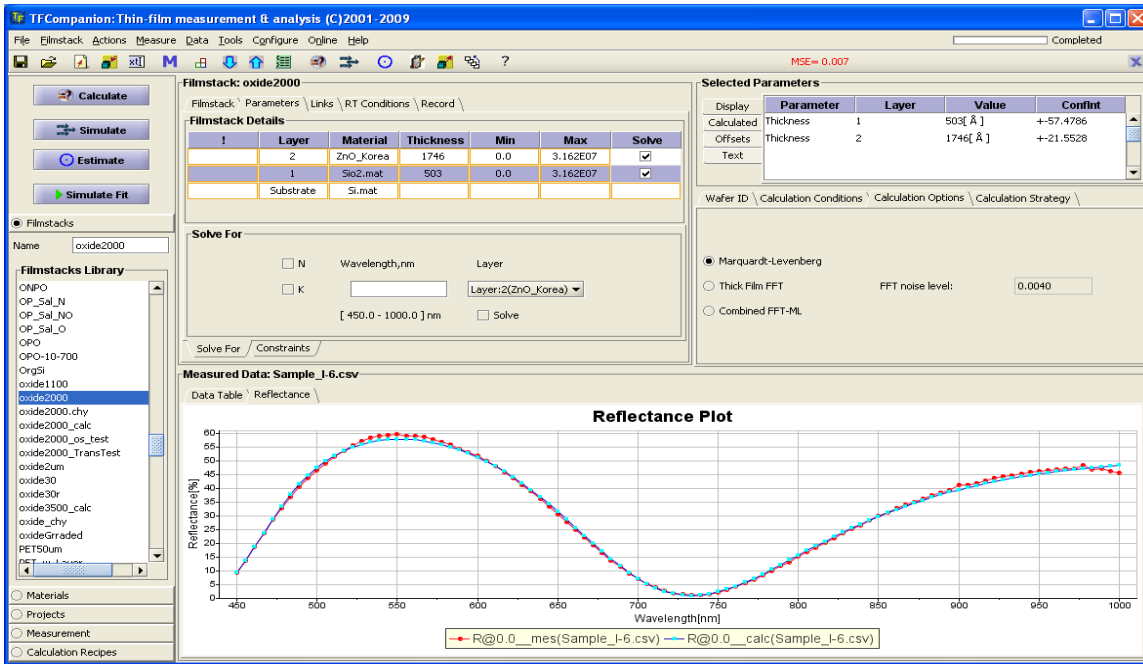
Fig. 4. Sample # 3(Fe3O4/SiO2/Si). Model to measured data fit. F3O4 dispersion is represented using CP Exciton model. 174nm Fe3O4/50nm SiO2/Si. Fe3O4 thickness and optical dispersion are determined from the measurement.
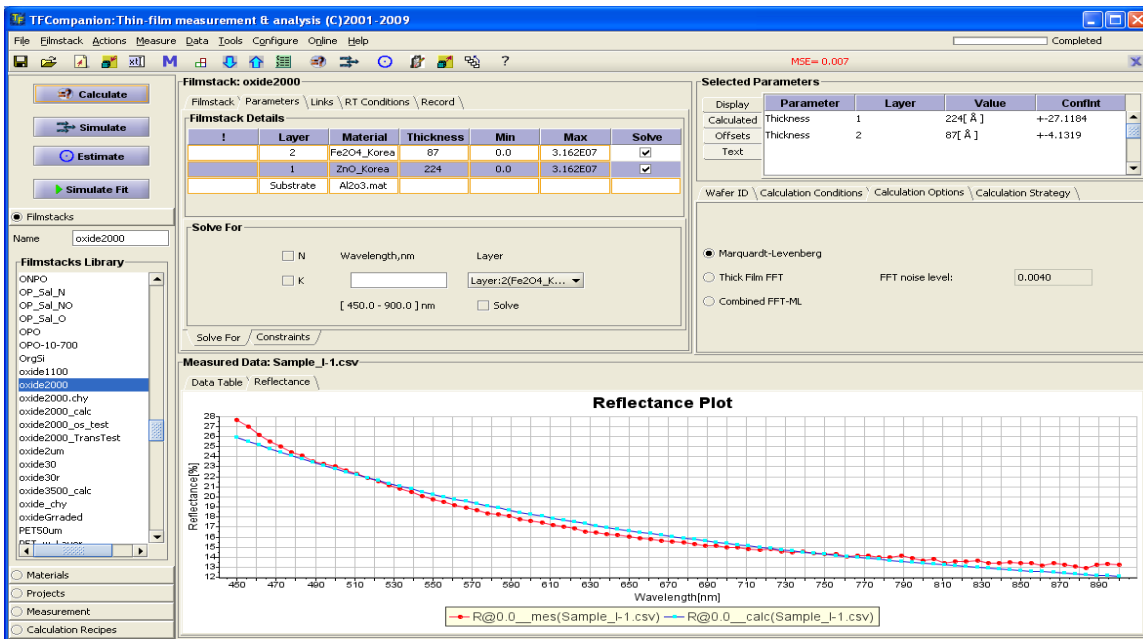

Fig. 5 Sample#4 (Fe3O4/AZO/Al2O3 (substrate)). Fit of the model to measured data. Thicknesses of Fe3O4 and AZO are determined from the measurement. Optical dispersion of the materials is taken from the previous measurements. : 8 nm Fe2O4/ 22 nm AZO/ Sapphire (substrate)
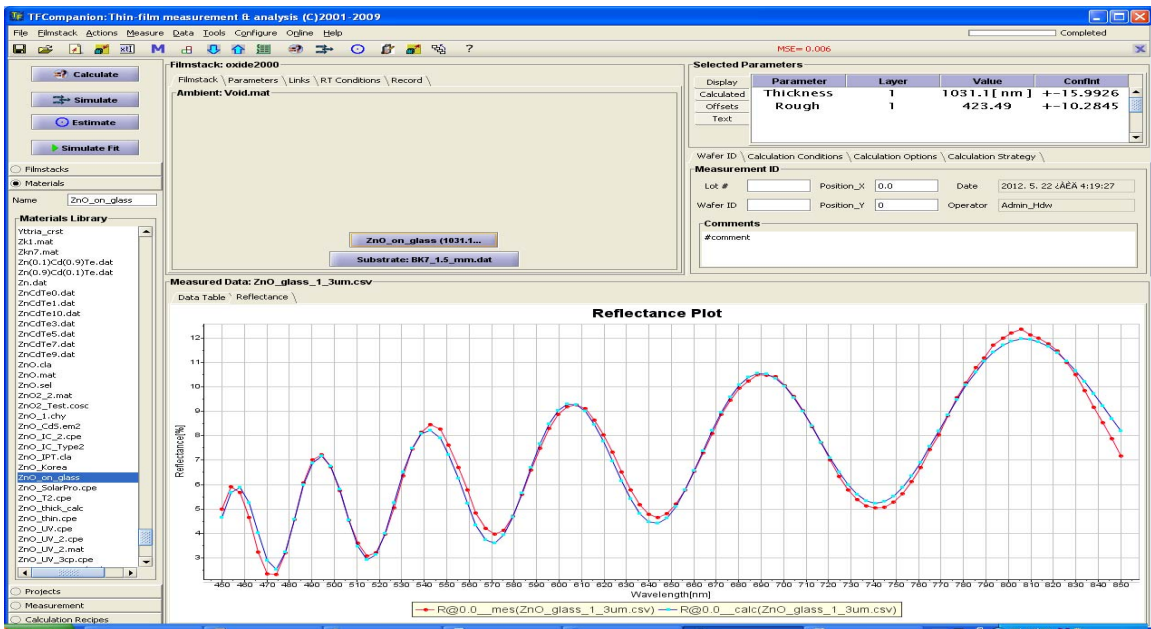
Fig. 6. Sample # 5. Thick AZO on glass. Model to measurement data fit. Thickness: 1031nm, surface roughness: 42nm
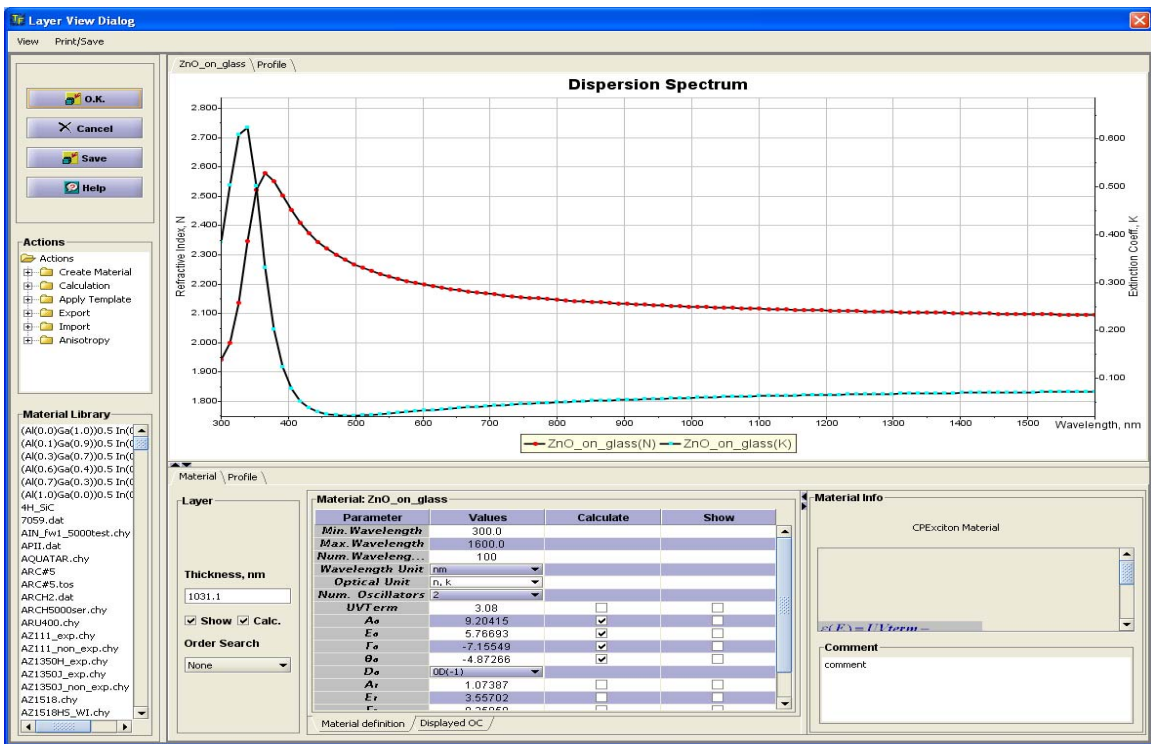

Fig. 7. Sample# 5 Optical dispersion spectra determined from the measurement. Dispersion is represented using CPExciton model
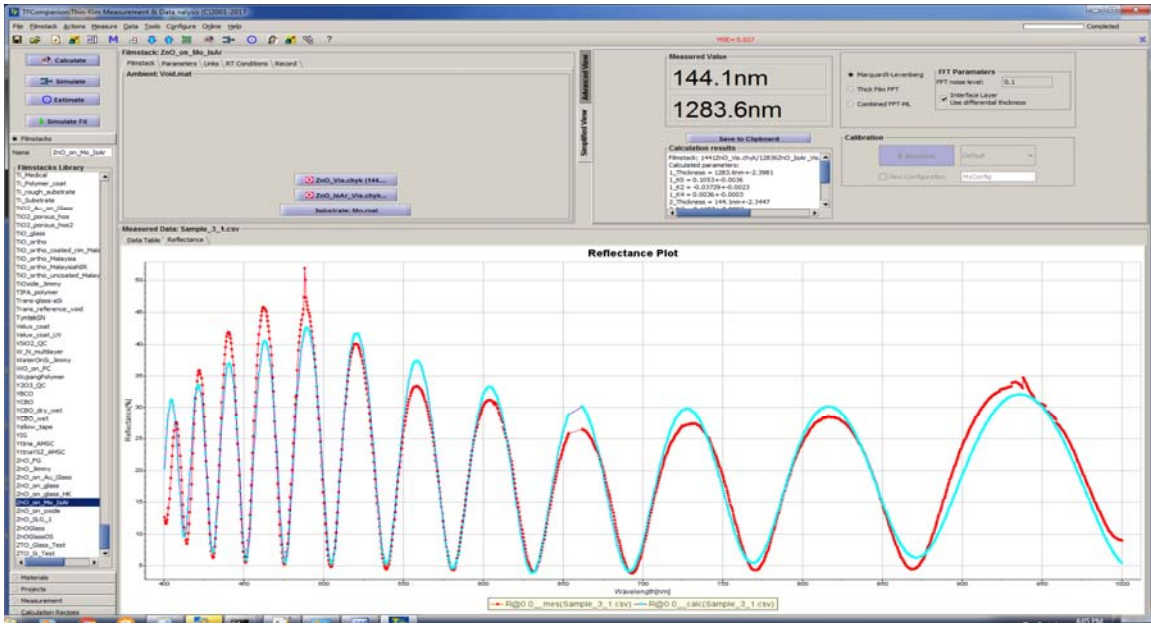
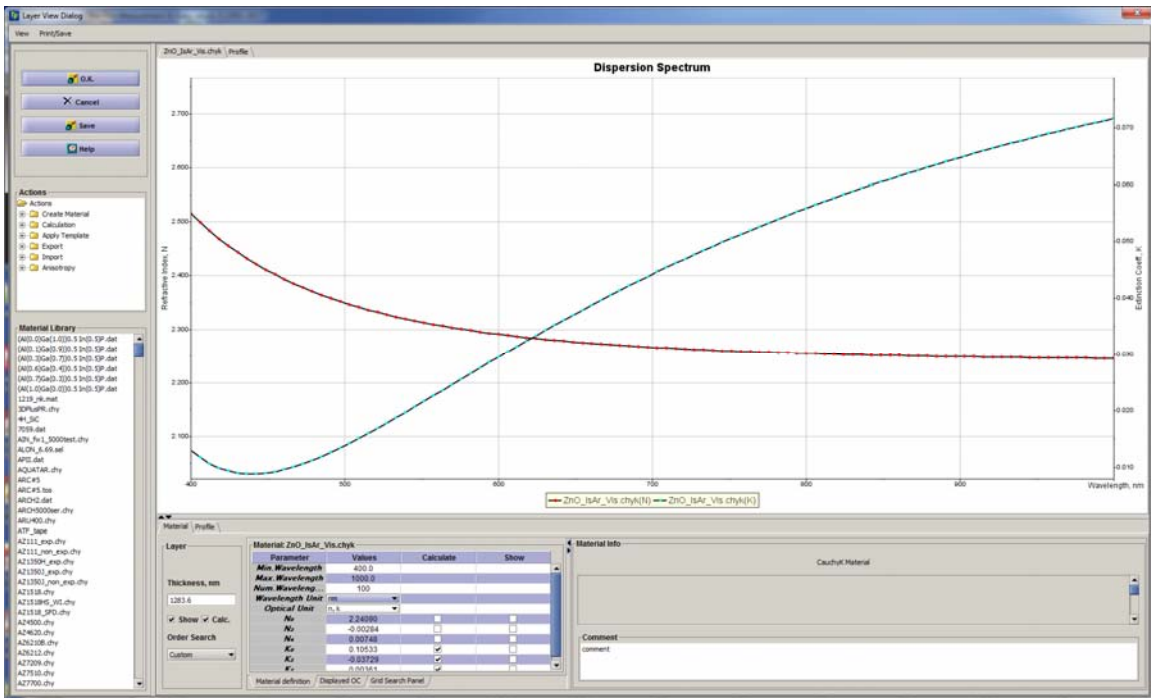Fig. 8 Sample #6 Two layers of ZnO on Mo. Bottom (thick layer) is Sc-doped. Measurement in the Vis range

Fig. 9 Optical dispersion of the Sc-doped ZnO layer