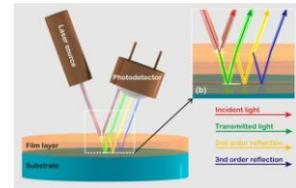# ThetaMetrisis APPLICATION NOTE #005

Thickness measurement of stack of films by White Light Reflectance Spectroscopy (WLRS)

**Goal**: The accurate measurement of the thickness of films in a stack consisting of 4 layers on a substrate.

Means & Methods: WLRS is introduced for the measurement of film thicknesses in the case of stack of dielectric and semiconductor films. All measurements were performed with an FR-Basic in the 400-1000nm spectral regime. The reflection probe had an active spot size of 1mm in diameter. The sample was a Si wafer with areas consisting of Si_3N_4 /SiO_2, poly-Si /Si_3N_4 /SiO_2, PMMA/poly-Si /Si_3N_4 /SiO_2. In all measurements a highly reflective Al coated mirror (NT01-913-533, Edmund Optics) was used for the reference measurements.

**Results**: In fig. 1 the reflectance spectrum from a Si_3N_4/SiO_2 stack on Si wafer is shown. The calculated thicknesses were: 576.63nm for SiO_2 and 127.78nm for the Si_3N_4. In fig. 2 the reflectance spectrum from a poly-Si/Si_3N_4/SiO_2 stack on Si is shown. The calculated thicknesses were: 578.45nm for SiO_2 and 144.77nm for the Si_3N_4 and 114.82nm for the polycrystalline Si. In fig. 3 the reflectance spectrum from a PMMA/poly-Si/Si_3N_4/SiO_2 stack (4 layers) on Si is shown. The calculated thicknesses were: 575.22nm for SiO_2 and 147.57nm for the Si_3N_4, 115.73nm for the polycrystalline Si and 132.38nm for PMMA. The individual thickness of each film is calculated simultaneously without any previous knowledge of the film thickness in all cases. In all cases, calculated film thicknesses were in very good agreement with the values obtained by spectroscopic ellipsometry (<1% difference).
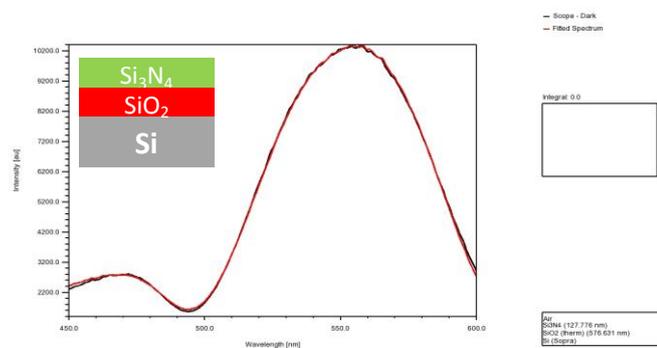
Figure 1: Typical reflectance spectrum from a Si_3N_4/SiO_2/Si sample (**raw data without normalization**). Black line: sample, Red line: fitting
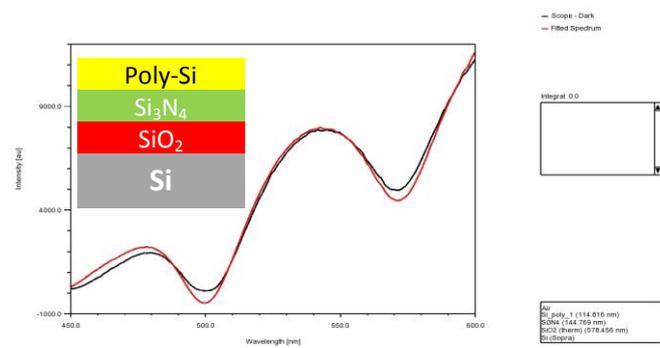
Figure 2: Typical reflectance spectrum from a poly-Si/Si_3N_4/SiO_2/Si sample (**raw data without normalization**). Black line: sample, Red line: fitting
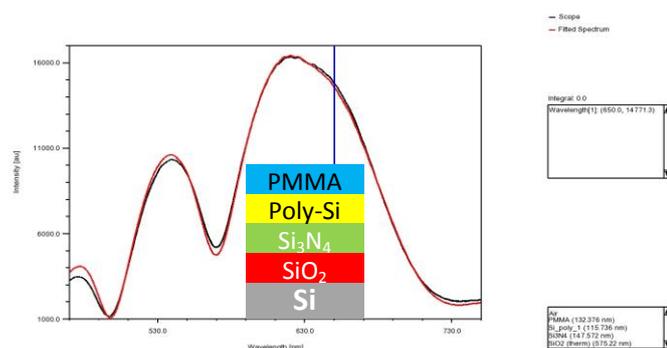
Figure 3: Typical reflectance spectrum from a PMMA/poly-Si/Si_3N_4/SiO_2/Si sample (**raw data without normalization**). Black line: sample, Red line: fitting

Conclusions: The thickness of at least 4 layers can be calculated simultaneously.