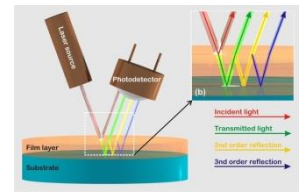


ThetaMetrisis APPLICATION NOTE #035

Local core and cladding thickness determination of planar waveguides



Introduction: Silicon based photonics systems, such as SOI and SiN, have attracted a considerable interest in recent years, trying to take advantage of the mature processing technology, which has been developed for the microelectronics industry. Cladding and core layer properties (thickness, refr. index, etc) are the most significant parameters of the waveguide design, which influence the optical confinement, bend losses and absorption [1].

Means and Methods: In this application note, we have measured **simultaneously**, the thickness of a three-layered stack (upper/bottom cladding and core) of a SiN waveguide, as seen in the schematic of **Figure 1a**, using the **FR-uProbe** tool attached in a Leica microscope (LMDM). The measurement was performed upon the area of the taper waveguide as seen in **Figure 2b**. The black square (4 μ m side) shown in the center of the image (acquired by 50X objective lens) indicates the spot size the reflectance of which is collected and its reflectance spectrum is further analyzed for the thickness determination of the layer(s).

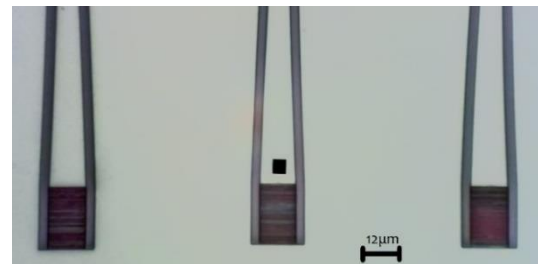
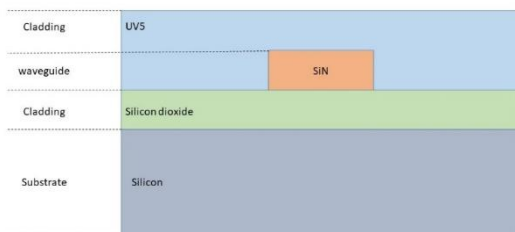


Figure 1. a) schematic of the layer stack of the planar waveguide, and b) image taken with of FR-uProbe's camera, indicating the measurement area and the waveguides from the top.

Experimental reflectance spectra (black line) obtained in the 450-700nm wavelength range, and the related fitting (red line) that is used to determine **simultaneously** the thickness of each layer are shown in **Figure 3** (left). The measured thickness values are shown in **Figure 3** (right). It should be noted that the thicknesses of the bottom cladding layer and of the core layer determined by this measurement are equal to the values determined prior to patterning.

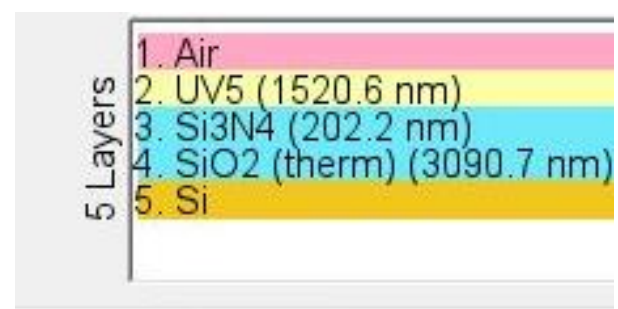
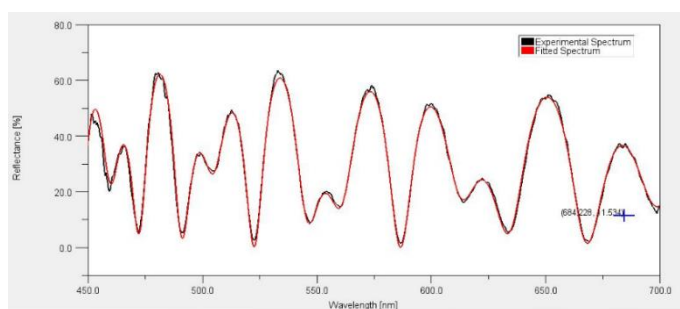


Figure 3. (left) the reflectance spectra obtained and (right) thickness measurement of each layer.

Conclusions: ThetaMetrisis' **FR-uProbe** tool is a unique powerful tool for the local measurement of thickness(es) of layers with spot size down to 2 μ m. Thanks to its modular design can be attached on any trinocular optical microscope enhancing this way the microscope capabilities without any effect on its performance.

References:

[1]D. J. Blumenthal, R. Heideman, D. Geuzebroek, A. Leinse, and C. Roeloffzen, "Silicon Nitride in Silicon Photonics," Proc. IEEE, vol. 106, no. 12, pp. 2209–2231, 2018.