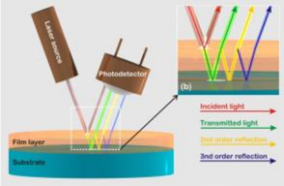
ThetaMetrisis APPLICATION NOTE #004

Theoretical prediction of the reflectance for any stack of films by White Light Reflectance Spectroscopy (WLRS)

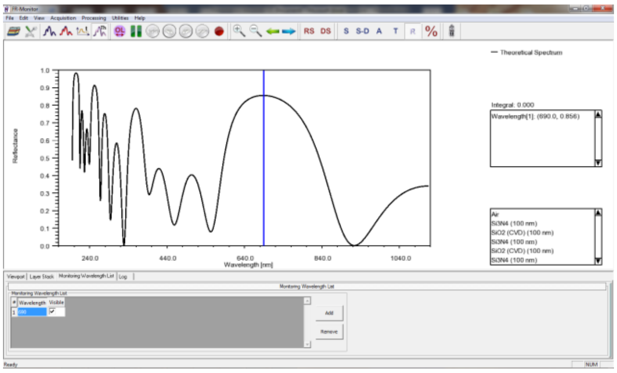


Goal: The accurate simulation of the reflectance of any stack of films.

Results: 1D Photonic Crystals (PCs) present some unique characteristics that allow for the manipulation of the light. For example a carefully designed multilayer of transparent films with medium or even low refractive index contrast could operate as Bragg filter reflecting a selected part of the irradiation spectrum.

FR-Monitor offers the unique characteristic of theoretical prediction of the reflectance of any film stack. This way the stack can be designed in order to present the desired properties and furthermore various processing parameters (such as film thickness variation, interfacial region etc.) could be also studied.

As a demonstration of this powerful feature of FR-Monitor the reflectance spectra for various multilayer stacks consisting of SiO_2/Si_3N_4 films are presented for demonstration. In fig. 1, the reflectance for a three double layers, each layer of 100nm, is illustrated. Clearly enhanced reflectance is monitored in the 580-880nm spectral range with maximum value of 85%. In fig. 2 the reflectance from 6 such double layers is illustrated. The maximum reflectance is 97% and the enhanced reflectance has been shrunk to the 600-830nm range. Further increase to 9 double layers, i.e. 1800nm total film thickness, causes further narrowing of the enhanced reflectance region to 610-800nm and slight increase of the maximum reflectance value to 99%, fig. 3. Finally in fig. 4 the effect of the insertion of an intermediate layer, 100nm HfO_2, at the middle of the 6 bilayer stack causes dramatic change in the reflectance spectrum.

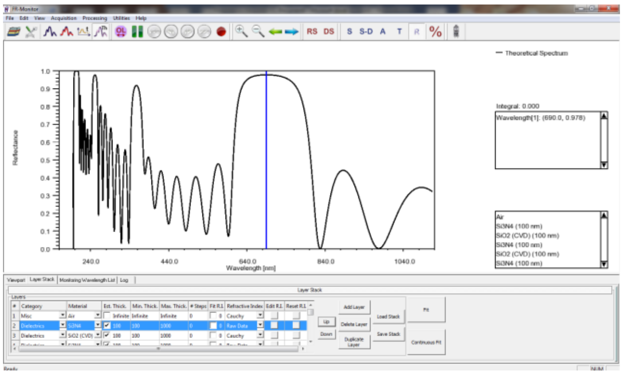


Integral: 0.000

Wavelength[1]: (690.0, 0.856)

Air
Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
Si3N4 (100 nm)

Figure 1: Theoretical reflectance from a stack consisting of three double layers. Each double layer consists of 100nm silicon dioxide and 100nm silicon nitride.

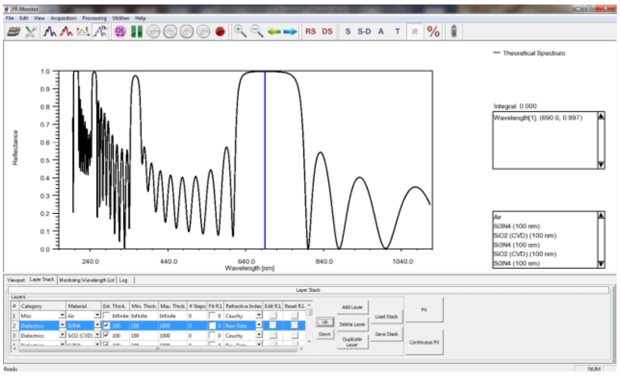


Integral: 0.000

Wavelength[1]: (690.0, 0.978)

Air
Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
Si3N4 (100 nm)

Figure 2: Theoretical reflectance from a stack consisting of six double layers. Each double layer consists of 100nm silicon dioxide and 100nm silicon nitride

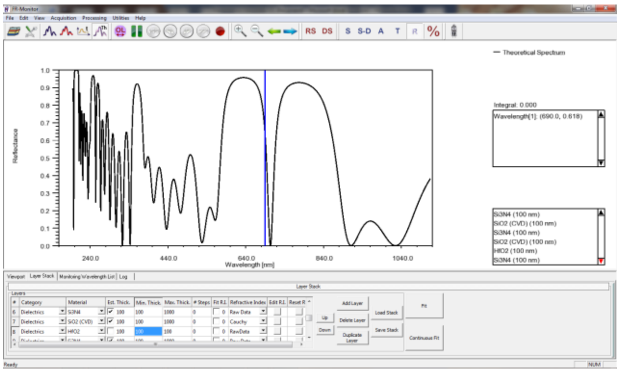


Integral: 0.000

Wavelength[1]: (690.0, 0.997)

Air
Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
Si3N4 (100 nm)

Figure 3: Theoretical reflectance from a stack consisting of nine double layers. Each double layer consists of 100nm silicon dioxide and 100nm silicon nitride.



Integral: 0.000

Wavelength[1]: (690.0, 0.618)

Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
Si3N4 (100 nm)
SiO2 (CVD) (100 nm)
HfO2 (100 nm)
Si3N4 (100 nm)

Figure 4: Theoretical reflectance from a stack consisting of six double layers and 100nm HfO_2 in the middle. Each double layer consists of 100nm SiO_2 and 100nm Si_3N_4.

For further information please contact us at info@thetametrisis.com or sales@thetametrisis.com