Scenario 190.01: Rigorous Analysis and Optimization of Pillar-type Antireflection Structure.

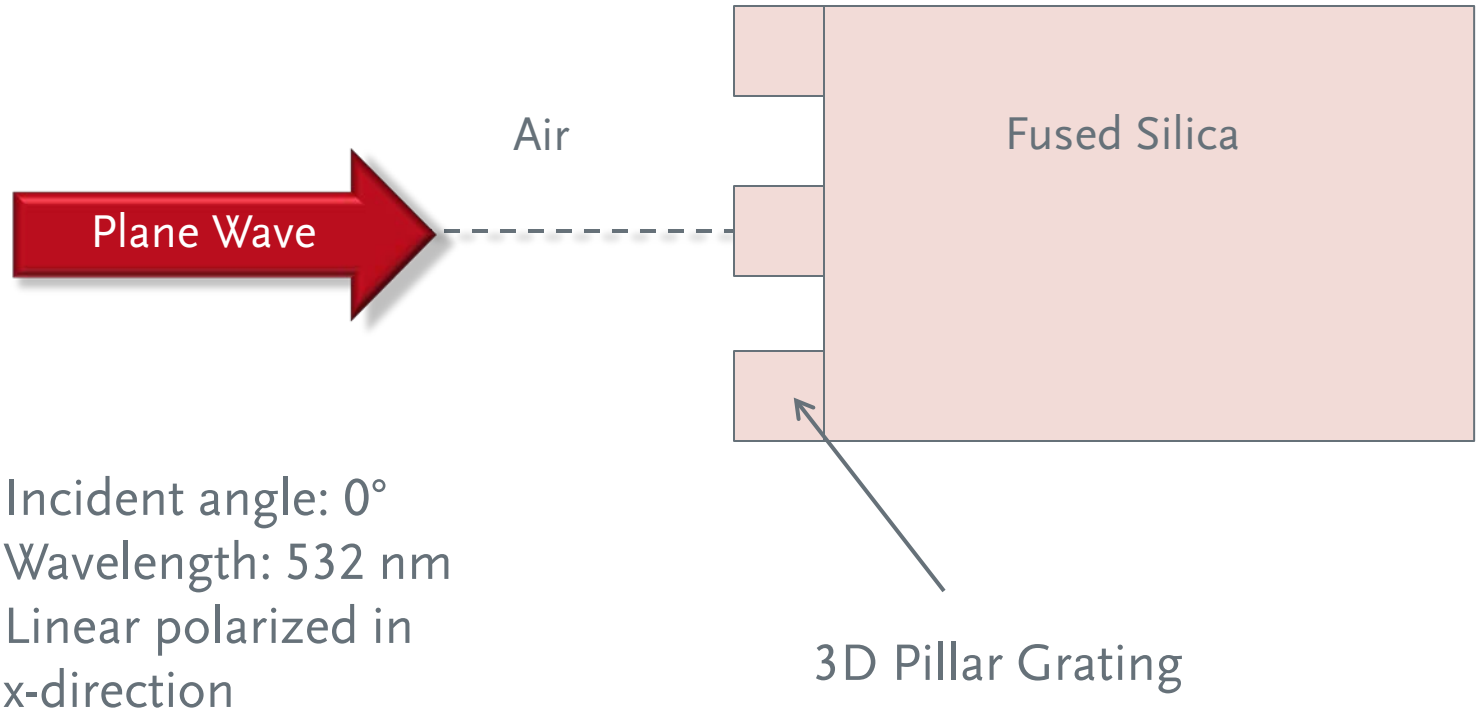
The optimization and analysis of a pillar-type sub-wavelengths antireflection grating by rigorous Fourier Modal Method is demonstrated in this example. The optimization of the grating parameters is done by the parameter run of VirtualLab.

Keywords: pillar, antireflection, grating, rigorous, FMM, sub-wavelength

Required Toolboxes: Grating Toolbox

LIGHTTRANS

Modeling Task



Incident angle: 0°
Wavelength: 532 nm
Linear polarized in x-direction

Modeling Task

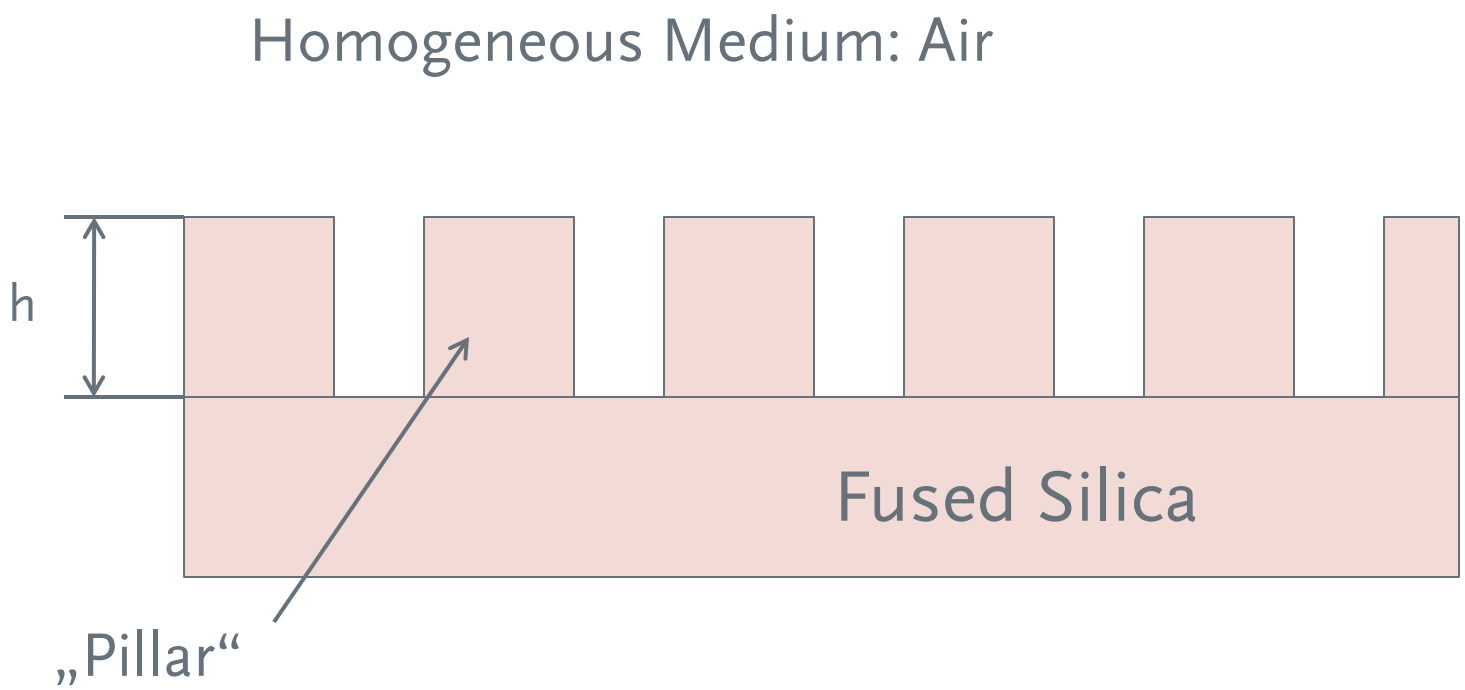
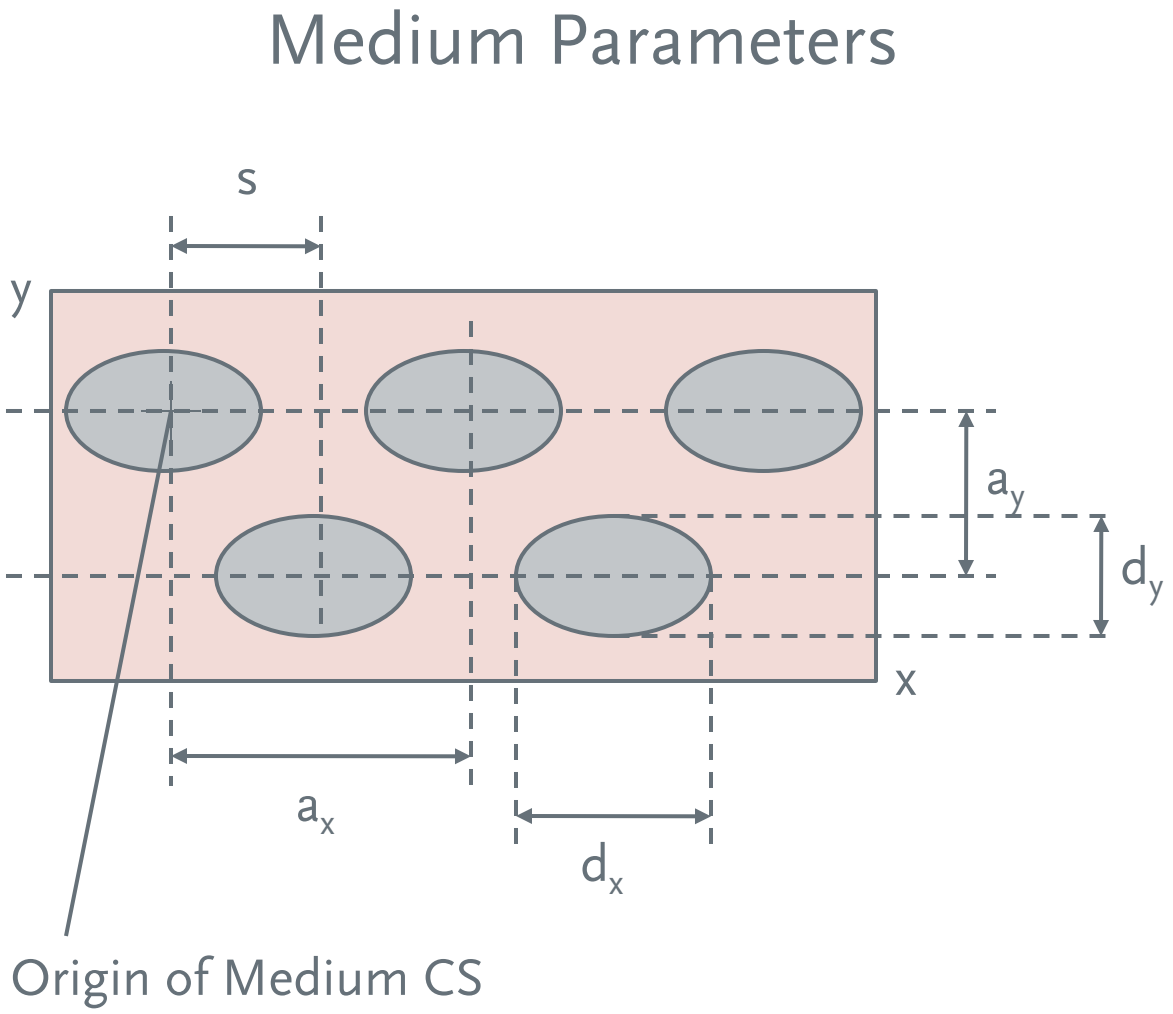


Figure 1: x-z-Cross section of Layer Stack

Modeling Task

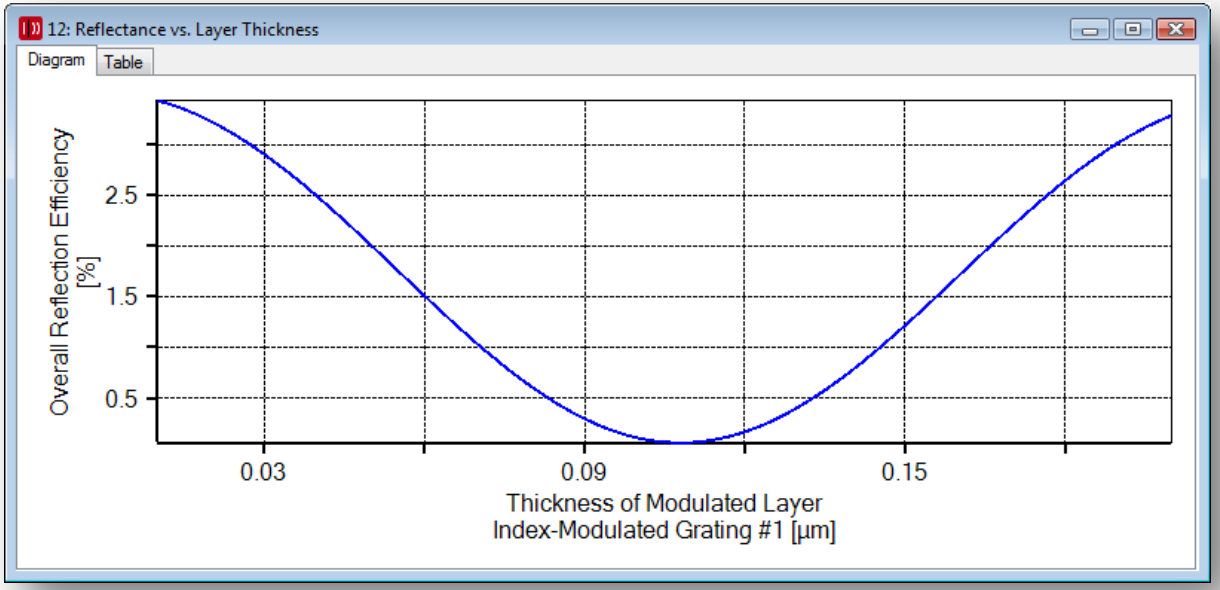


Modeling Task

- Optimization of grating parameters so that no reflection will appear for perpendicular incident light with 532nm wavelength.
- Most critical parameters are pillar diameter and layer thickness.
- Optimization can be done by varying all free parameters after each other by the parameter run.

Optimization of Depth

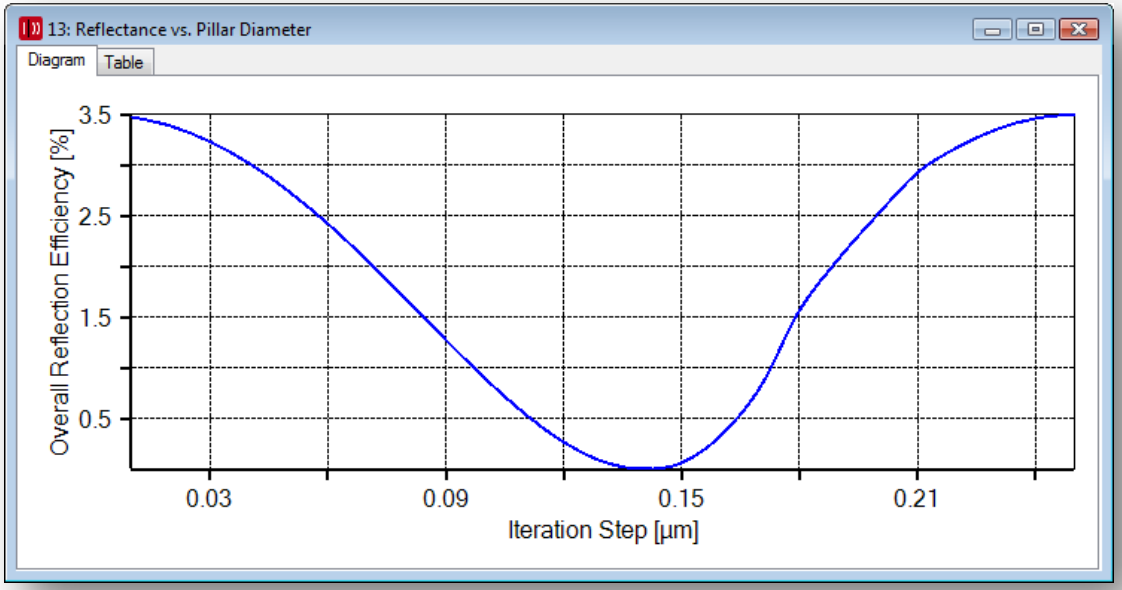
Reflectance vs. Depth (TM Polarization)



Minimum reflectance for 110 nm depth.
Parameter run see ‘Scenario_190.01_Pillar_Grating_2.run’

Optimization of Pillar Diameter

Reflectance vs. Pillar Diameter (TM Polarization)



Minimum reflectance for 140 nm depth.
Parameter run see ‘Scenario_190.01_Pillar_Grating_3.run’

Optimization Results

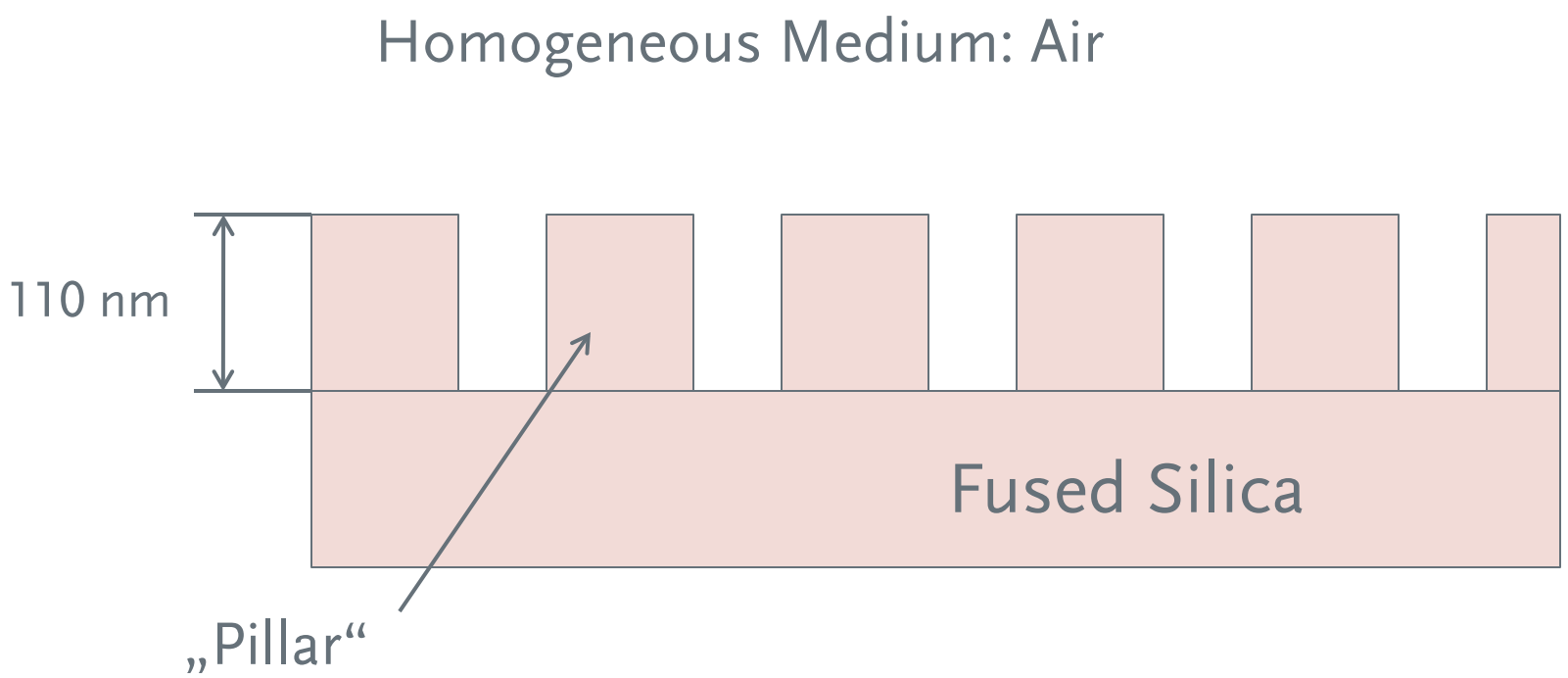
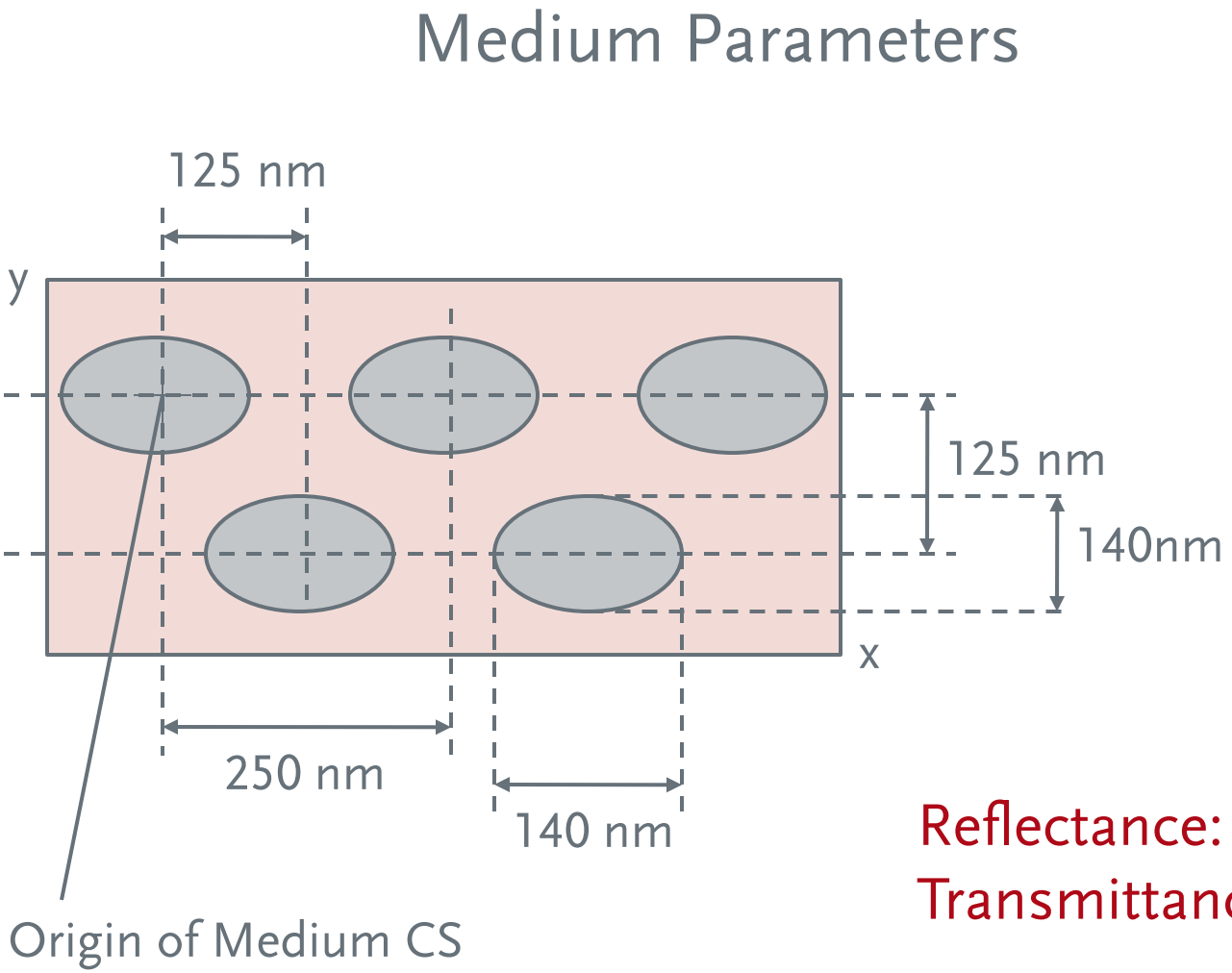


Figure 1: x-z-Cross section of Layer Stack

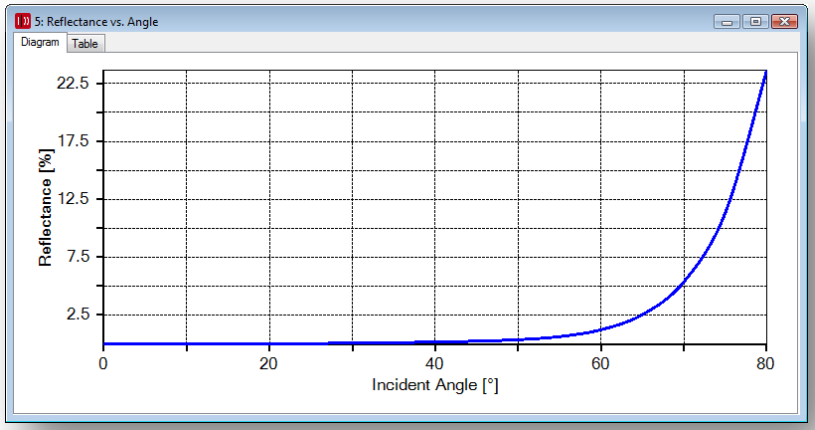
Rigorous Analysis of Pillar-Type Gratings

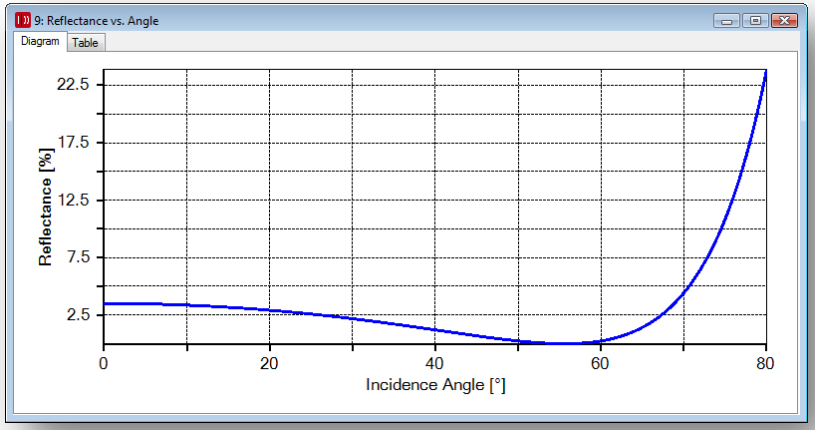


Reflectance: 0%
Transmittance: 100%

Analysis of Angular Dependency

Reflectance vs. Angle (TM Polarization)





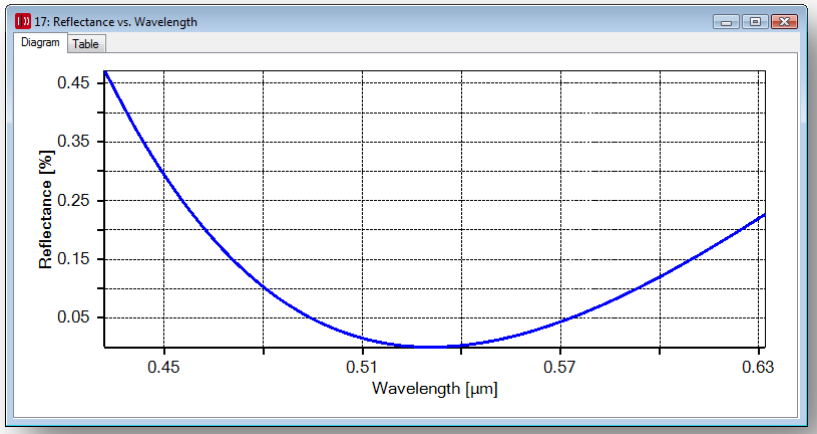
Reflectance antireflection structure

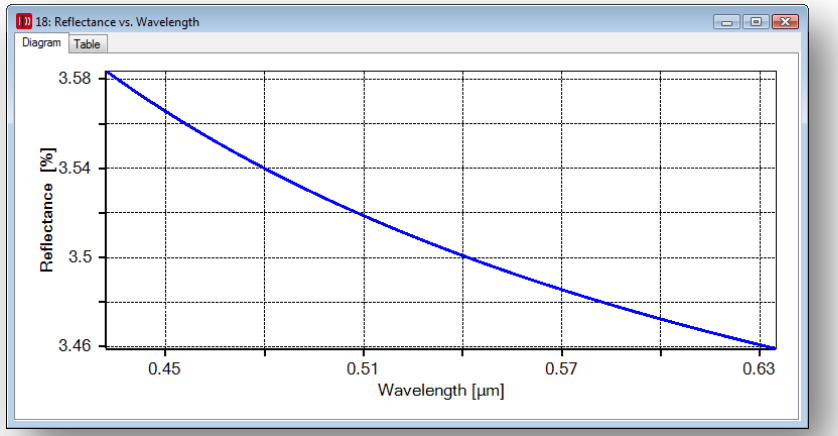
Reflectance plane surface

Parameter run see ‘Scenario_190.01_Pillar_Grating_4.run’

Analysis of Wavelength Dependency

Reflectance vs. Wavelength (TM Polarization)





Reflectance antireflection structure

Reflectance plane surface

Parameter run see ‘Scenario_190.01_Pillar_Grating_5.run’

Conclusion

- Grating Toolbox of VirtualLab enables rigorous analysis of 3D gratings by Fourier Modal Method.
- Optimization of grating of sub-wavelengths gratings can be done by parameter run.
- Analysis of angular and wavelengths dependency of gratings by parameter run.