Problem Description

This research is to investigate the property of a nano-grating by COMSOL 4.2a. Shown in fig.1 is the structure of a model to calculate the reflection and transmission of a 2D infinite long plane with periodic shallow notches. This structure is regarded a grating. Polarized "out of plane" light wave comes from top to down with an incident angle α.

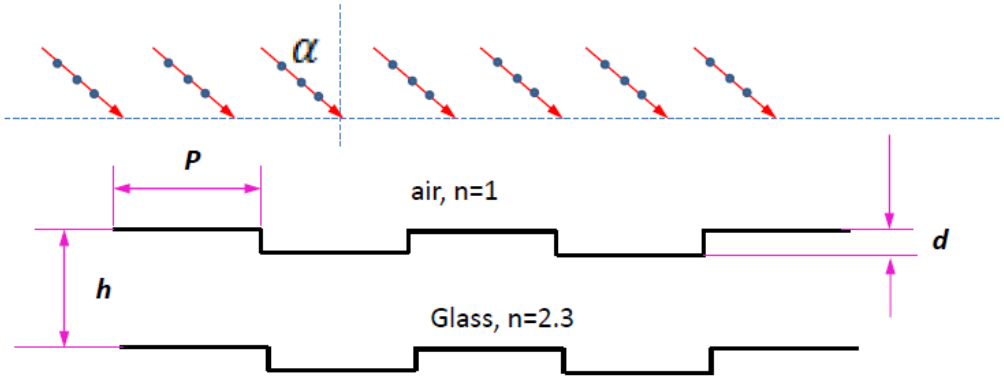

Fig.1 the dimension of grating

To simplify this model, we only chooses one unit and utilize the Floquet boundary. In the COMSOL file, we only plot one unit shown in fig.2. There are two ports: port 1 (light comes in) and port 2 (light comes out). Other related parameters are listed in the following table.

parameters	description	value
α	Incident angle	Sweep from 0-pi/2
lamda	Wavelength of light	623.8nm
p	Half grating constant	185nm
h_0	thickness	190nm
d	depth	5nm
n1	Refractive index of glass	2.3
n2	Refractive index of air	1

We use the Floquet periodicity at the two edges of the tooth of grating, shown in Fig.2. Meanwhile, we choose the incident/transmission distances (from the grating surface to the port 1 and port 2 respectively) over half wavelength (311.9 nm) .

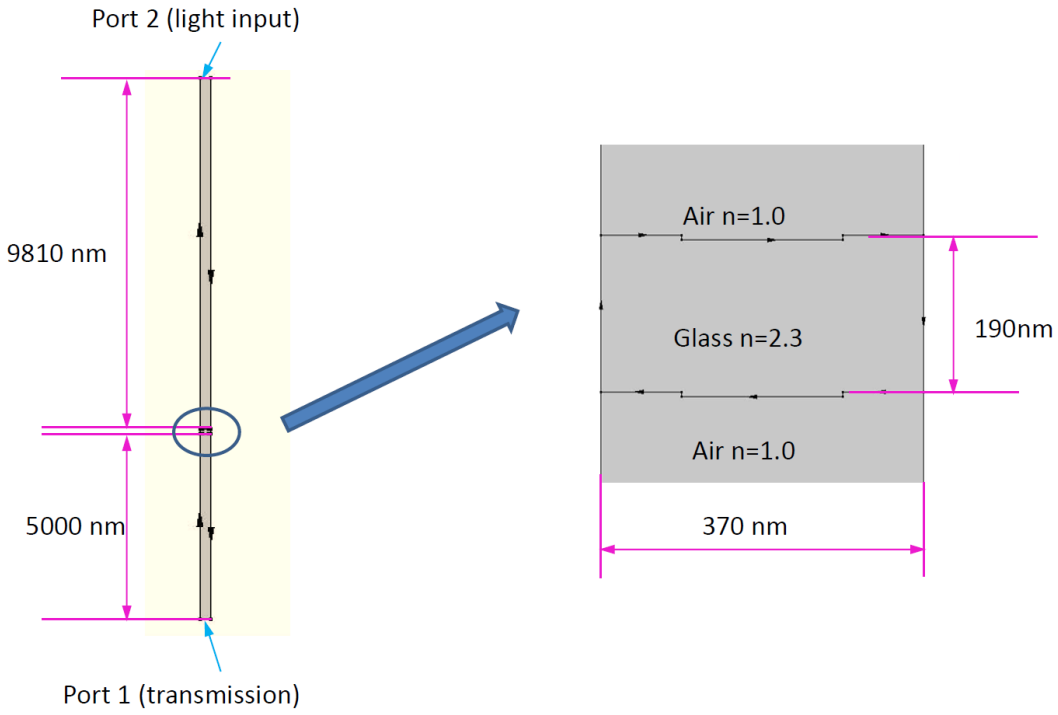

Fig.2 Calculated model in COMSOL

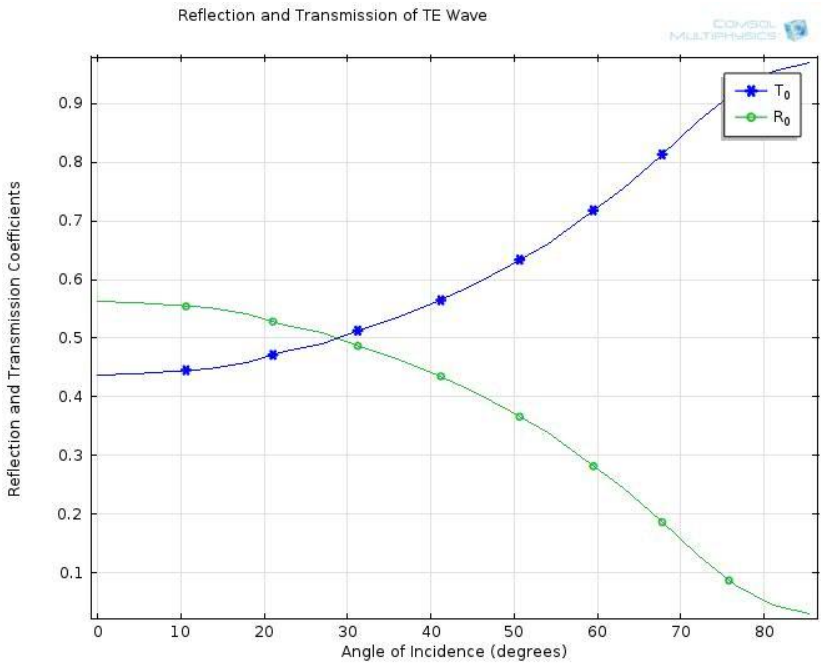

Fig.3 d=5 nm

Question

1. Different grid size are applied in the fig.3 (raw) and Fig.4(finer) respectively. There are several oscillations in reflection and transmission coefficients (RTC) curve of TE wave in Fig.4. Moreover, if I decrease the gird size or sweep step, there will be more oscillation. I trust the model is correct and the rough trend of this curve may be right. However, from our understanding, there should be no such oscillation. (See the reference 1). The result is confusing for me.

Does FEM will lead to a slight oscillation if the parameters such as the grid size are not appropriately setup? Moreover, we note that many peaks exist from large incident angle from 30-60°. How can we control the sweep step in this condition.

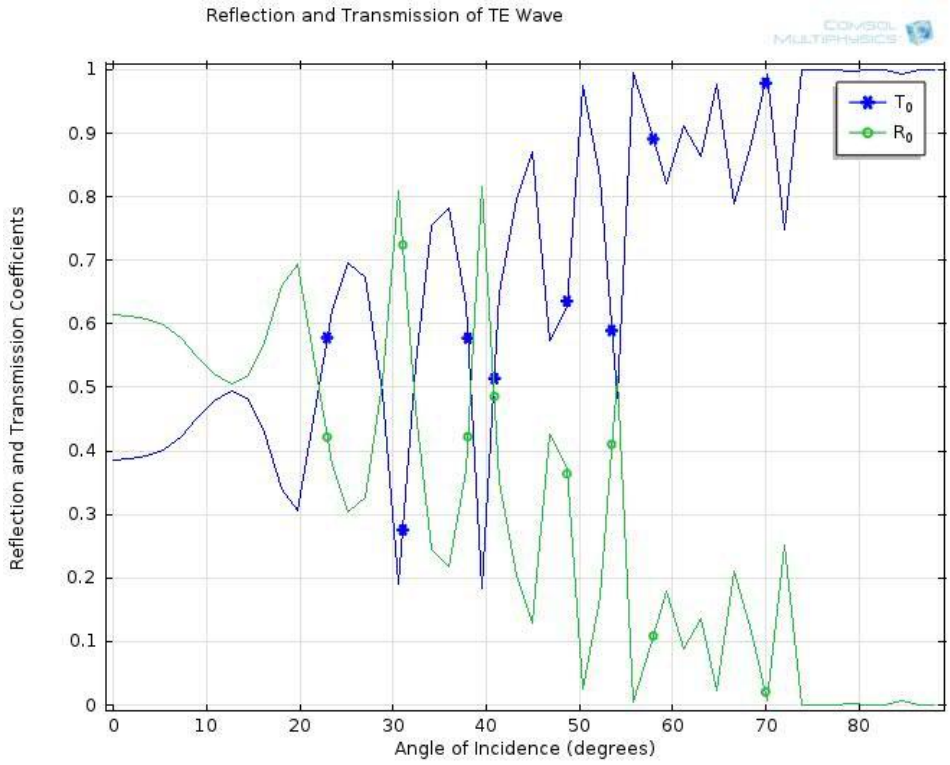

Fig.4 d=5 nm

References

Mashev, L.; Popov, E., Zero order anomaly of dielectric coated gratings, Optics Communications, Volume 55, Issue 6, p. 377-380.