Plasmonic Scattering Structures for Improved Performance of Thin Film Solar Cells

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Introduction: Thin film photovoltaics is a promising technology for the growth of solar industry. A circular and corrugated circular shaped plasmonic structural configuration is considered as shown in Fig 1a and Fig 1b, respectively. The effectiveness of these structures for enhancing the absorbance and broad band response is investigated

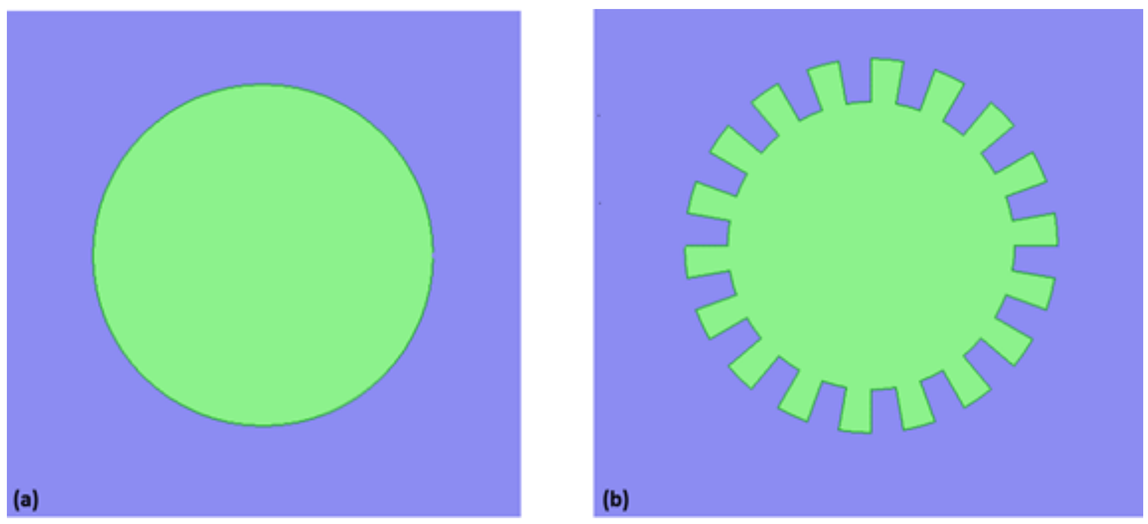

Fig 1. Circular (a) and corrugated (b) plasmonic structures.

Computational Methods: Time-harmonic wave equations in the electric field *E* and the magnetic field *H*:

$$\nabla \times \nabla \times \vec{E} - n^2 k_0^2 \vec{E} = 0$$

$$\nabla \times (\frac{1}{n^2} \nabla \times \vec{H}) - k_0^2 \vec{H} = 0$$

Where, n , complex refractive index
k_0 , magnitude of the free-space wave

Novel multilevel scattering element is investigated to increase the solar absorbance. Nano plasmonic scattering structures embedded in a dielectric medium is modelled as electromagnetic wave propagation in the frequency domain with periodic boundary conditions.

Results: Figure 2 shows the results contour plots of electrical field normal for both the shapes. Figure 3a and 3b shows, reflection, transmission and absorption coefficient of circular and corrugated circular structures, respectively. The results show the increase in absorbance coefficient of corrugated circular structures and improved broadband response.

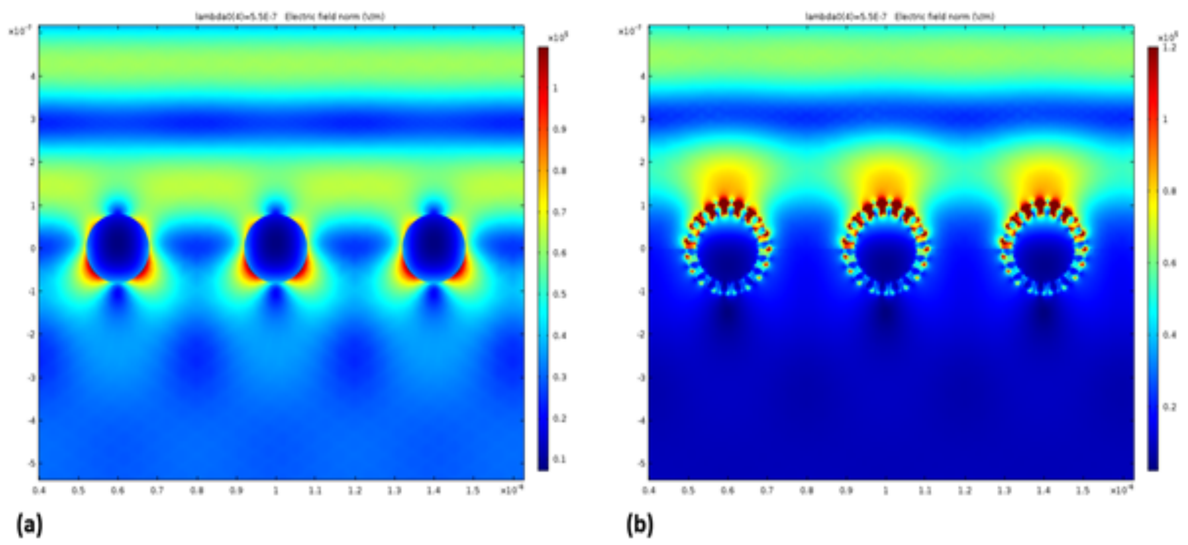

Fig 2. Electrical field contour plot of Plasmonic structures

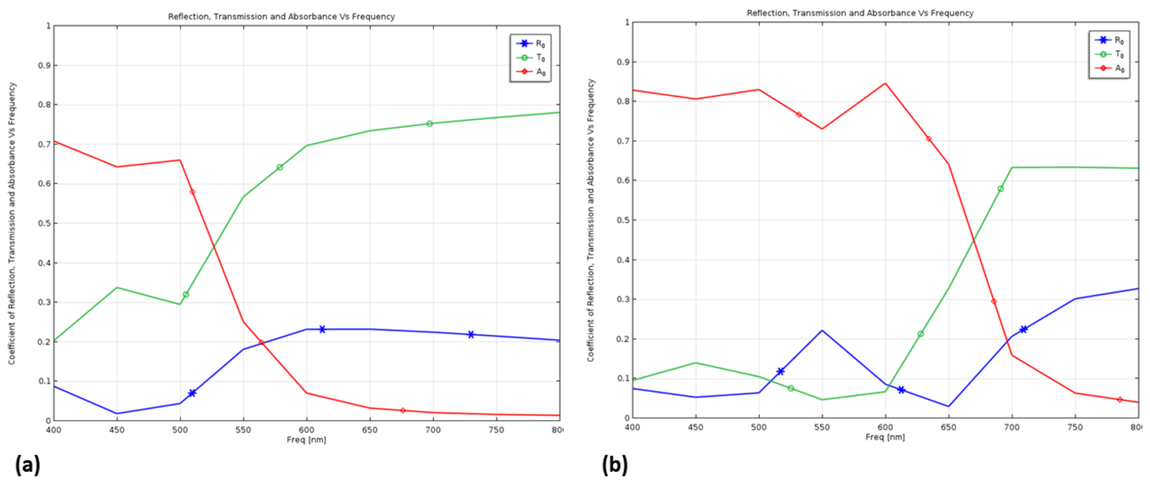

Fig 3. Reflection,transmission and absorbance Vs Freq.

Conclusions: In this paper Computational electromagnetic investigation demonstrated the potential for increasing the solar absorbance and broadband response of thin film solar cells by multi-level plasmonic scattering elements. Highly efficient plasmonic structures can fuel the solar Photovoltaics industry growth and proliferation of low-cost thin film solar cells.