Down and up conversion layers for enhancing the performance of crystalline silicon solar cell efficiency.

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World energy demand is increasing rapidly due to the advances in technology. The demand is expected to be more than double the amount by the year 2050. Recently, more attention have been focused on solar energy as an alternative source to generate sufficient energy. Solar cells are devices which converts solar energy into electrical energy through the use of photovoltaic effect. The maximum theoretical conversion efficiency for crystalline silicon (c-Si) solar cell is 25%. The major problem in improving the conversion efficiency of Si solar cells is the mismatch between the solar spectrum and the energy bandgap of Si. This is ascribed to the fact that Si solar cells only absorbs photons with energy matching its bandgap (i.e. Eg = 1.1 eV). Generally, photons with energy higher than the bandgap are not absorbed. However, upconversion (UC) and downconversion (DC) luminescent materials have been explored for improving the energy conversion of c-Si solar cells. The UC layer is placed at the bottom of c-Si solar cell to minimize non-absorption energy losses while the DC layer is placed on top. Y_2O_3: Ho^{3+}, Yb^{3+} nanophosphors are well researched for improving conversion energy of c-Si solar cell. However, the transmittance loss due to high reflectance of Y_2O_3: Ho^{3+}, Yb^{3+} is always the biggest challenge. Therefore, antireflective materials, SiO_2 are coated with Y_2O_3: Ho^{3+}, Yb^{3+} nanophosphors to reduce the reflectance. The antireflective coating also promote the optical transmittance in the visible and NIR range which matches with the range of the bandgap energy of silicon. This study focuses on enhancing the performance of c-Si solar cell efficiency using DC and UC layers.

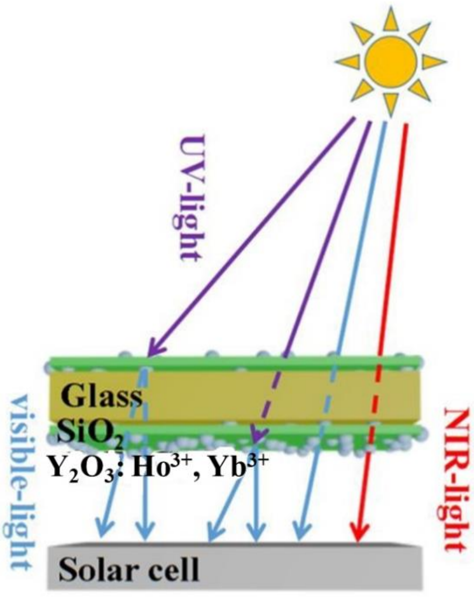

Figure 1: Schematic diagram of solar cell with antireflection coating (SiO_2).