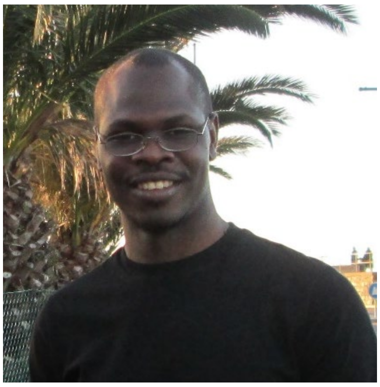

Luminescent materials/silicon combination Solar Cells

Mubarak YAGOUB

Luminescent materials capable of converting high photons (ultraviolet (UV)/blue) or Infrared (IR) light to NIR photons. Owing to their efficient conversion ability, luminescent materials are particularly attractive for enhancing Si solar cells' efficiency. In this context, up or down-conversion layer-based luminescent materials can be integrated/combined with Si solar cells. In such a configuration, the down-conversion luminescent layer can be placed on top of the Si solar cells which converts every one of UV/blue photon to two red or near-infrared (NIR) photons (Fig.1). On the other hand, the up-conversion layer should be placed beneath a bifacial solar cell to absorb and convert the transmitted photons (those photons that have lesser energies than the bandgap of the solar cell) to higher energy photons back to the solar cell where they can be efficiently absorbed (Fig. 2). Such a combination is expected to overcome the single-junction power conversion efficiencies (PCEs) limit of silicon solar cells.

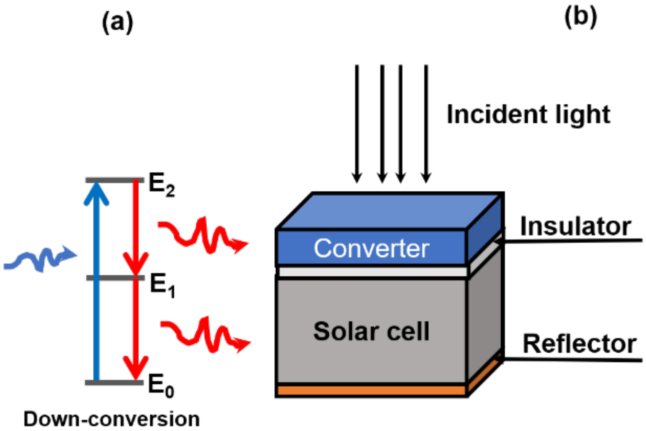

Figure 1. Schematic energy diagrams of (a) Down-conversion process and (b) a schematic representation of a solar cell with a down-converter layer.

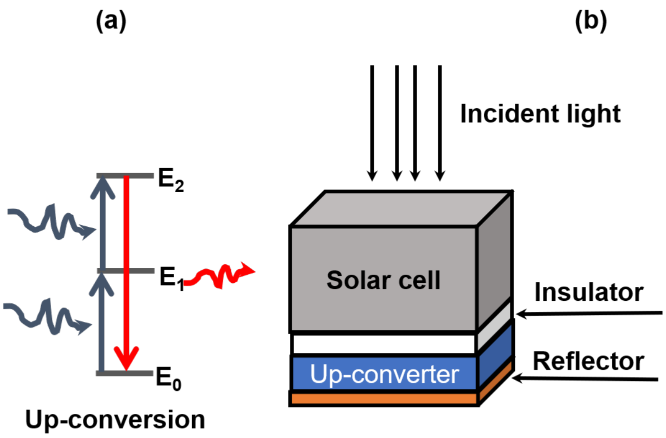

Figure 2. Schematic representation of (a) up-conversion process and (b) a solar cell with an up-converter layer.

Currently, both down-conversion and up-conversion luminescent materials are already being independently developed within our group and high quantum efficiency are available for such application. In this project, we are addressing the challenge of how to combine both mechanisms with Si solar cells. Specific points of attention for this are:

1. The fabricating of the converting layer, requiring deposition of the luminescent layer on top of the solar cells. To this end specific attention must be given to the processing and thickness of the converting layers to optimize the light reflection.
2. Deposition of antireflection. The converted photons need to be efficient and highly directed to the solar cells. Besides, the antireflection layer needs to be highly transparent, particularly in the UV and blue as well as near-infrared range, to allow this portion of the solar spectrum to be absorbed by converted layer and the solar cell.
3. The stability of the luminescent layer. The luminescent layer must be high stable within the surrounding environment as the Si solar cells.

By addressing these challenges, this project aims to increase the PCE by more than 10%.