Model Calculation of the Effectiveness of Tb^{3+} Containing Glass as a Wavelength Converter in Thin Film Solar Cells

Marushka Sendova-Vassileva

Central Laboratory of Solar Energy and New Energy Sources, Bulgarian Academy of Sciences, 1784 Sofia, Bulgaria. *E-mail:* marushka@phys.bas.bg

As a way to achieve higher efficiency of third generation solar cells wavelength converters have been proposed as one of the ways forward. The idea is to shift the wavelength of the light which is absorbed by the solar cell to the spectral region where the device is most efficient. Higher energy photons are often absorbed unproductively near the front contact of the solar cells or the carriers generated by them recombine before being separated. By the application of photoluminescent materials these photons are transformed into longer wavelength ones, which contribute more effectively to the generated photocurrent.

In this contribution the improvement that a wavelength converter containing Tb^{3+} ions can effect on the efficiency of a thin film silicon single junction solar cell under AM 1.5 solar radiation is assessed by model calculations. The absorption and emission of a specified number of Tb^{3+} ions in a fluoride glass layer or plate is calculated on the basis of literature data. It is presumed that such a plate is placed in front of the solar cell and modifies the solar spectrum falling on it. This modified solar spectrum is used to calculate the efficiency of two model solar cells, an amorphous silicon and a microcrystalline silicon one, using the program Afors-Het 2.2. The amount of Tb^{3+} ions per unit area in the wavelength converter layer is varied. In the best case the efficiency of the a-Si:H solar cell improves by 1% and that of the microcrystalline silicon cell – by 2.3%, in comparison to that calculated with the unmodified AM 1.5 spectrum.