The use of nanotechnology techniques to make $In_xGa_{1-x}N$ multijunction with up to 40% photovoltaic efficiency

Bouazzi A.S., Hamzaoui H.

University of Tunis El-Manar, 2092 Tunis-El-Manar, Tunisia

asbouazzi@gmail.com

Abstract

The oil shortage in the medium term as well as the environment deterioration concern push researcher to explore new sources of energies. Photovoltaic (PV) solar energy conversion remains a clean and an easy to use converter, but efficiencies are low and cell prices are very high. Enhancing the efficiencies with using the same amount of material and the same area may solve the problem. A p-n junction solar cell can convert only a part of the solar spectrum with energy which is greater than the gap at the barrier. Rainbow cells could contain enough junctions in series with different gap energies to convert all the colors of the solar spectrum. Indium Gallium Nitride alloys $In_xGa_{1-x}N$ have energy gaps lying between 0.7 eV and 4.2 eV. Thus, if used for photovoltaic applications, they can lead to realize tandem cells with a greater number of junctions and could so eventually absorb most of the solar spectrum.

In this frame, we carried out research on multijunction solar cells. The simulations of $In_xGa_{1-x}N$ structures under solar illumination permit the optimization of the geometrical dimensions and electrical properties of the materials. This paper presents the results of the simulations, which show that we can reach 40% efficiency with GaInN rainbow PV cells if we stack six junctions together. Classical ways have been used worldwide to make these structures but did not succeed to make good cells. We propose to use nanotechnology technique to solve the problems of manufacturing.