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Nano particles surface plasmons for light trapping

Yongan Tang

North Carolina Central University, USA

Abstract

One major challenge for photovolatics solar cell is to improve its light-to-electrical conversion efficiency while reducing its cost and weight. Many methods are investigated by scientists to conquer this challenge. Thin film solar cells satisfy the demand of the high efficiency, low cost, and low weight. Since most of the solar cells are based on the crystalline silicon wafer with the thickness between 200 and 300μm, and around 40% of the cost is the silicon wafer. The hydrogenated alloy of amorphous silicon (a-Si:H) has high optical absorption than other materials, a-Si:H thin film solar cells are able to improve the absorption efficiency, since the minority carrier diffusion length is less than or around 300nm for amorphous silicon. However, a limitation in all thin film solar cell technologies is that absorbance of red spectrum is too small, because of silicon indirect bandgap. To overcome these light-trapping problems and to increase light absorption, new method based on excitation of surface plasmons via scattering from noble metal nanostructures was explored. We study the optical absorption efficiency of the a-Si:H thin film with nano-metallic particles, and investigate the size and shape of these nanoparticles. Our research shows that for a 100nm thick a-Si:H thin film deposited with an array of nano-metallic cubes or cylinders, the optical absorption will increase dramatically in the red light (e.g. 650nm), and the incident light with an angle has better absorption too.

Biography

YT graduated from University of Arkansas, and works on the nano-device development at NCCU since 2006; he does simulations with FDTD method and other methods, and he does fabrications in the clean room as well. BV is the director of CREST, and he works on nanotechnologies and many other areas.