17p-S10-8

PLASMONIC SOLAR CELLS

K.Mohan[1], Priyanka Choudhury [2]

E-mail: [1]tkpt.mohan@gmail.com , [2]pkc431@yahoo.com

Abstract

The scattering from metal nanoparticles near their localized.plasmon resonance is a promising way of increasing the light absorption in thin-film solar cells. Enhancements in photocurrent have been observed for a wide range of semiconductors and solar cell configurations. We review experimental and theoretical progress that has been made in recent years, describe the basic mechanisms at work, and provide an outlook on future prospects in this area.

Photo voltics has the potential to make a large contribution to solving the problem of climate change. To make electricity from photovoltaics competitive with fossil fuel technologies, the price needs to be reduced by a factor of 2-5 (depending on the local price of electricity generated from fossil fuels). Currently 90 % of the solar cell market is based on crystalline silicon wafers, with thicknesses of 200-300 µm. Around 40% of the cost of a solar module made from crystalline silicon is the cost of the silicon wafers. Because of this, there has been a great deal of research on thin-film solar cells over the past ten years. Thin-film solar cells have thicknesses usually in the range 1-2 µm, and are deposited on cheap substrates such as glass, plastic or stainless steel. They are made from a variety of semiconductors including cadmium telluride and copper indium diselenide, as well as amorphous and polycrystalline silicon. A major limitation in all thin film solar cell technologies is that their absorbance of near-bandgap light is ineffective, in particular for the indirect-bandgap semiconductor silicon.

Therefore, structuring the solar cell so that light is trapped inside, in order to increase the absorptance, is very important. Because silicon is a weak absorber, light-trapping is also used in wafer-based cells. For wafer cells, pyramids with a size of 2-10 µm are etched into the surface. For thin-film cells with thicknesses in the micron range, surface texturing with these dimensions is not suitable, so new methods must be found. It is possible to achieve light-trapping by forming a wavelength-scale texture on the substrate and then depositing the thin-film solar cell on top, and large increases in photocurrent have been achieved in this way [1, 2]. However, a rough semiconductor surface results in increased surface recombination, and semiconductors deposited on rough surfaces typically have low material quality.

A new method for increasing the light absorption that has emerged recently is the use of scattering from noble metal nanoparticles excited at their surface plasmon resonance