ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
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Chapter 017

Inorganic / Organic /Inorganic Double Junction Thin Film Solar Cells

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Keywords: Inorganic, Organic, Redox couple, Multijunction, Photovoltaic properties.

Abstract. Recent advances in photovoltaic technology have made materials (other than silicon) in combination attractive for the design of solar cells. Designers layer semiconductor materials with differing band gap energies to result in higher conversion efficiencies. In this work multijunction cells consist of multiple thin films produced using electrochemical deposition technique on ITO glass substrates have been fabricated and characterized. Each cell configured as, ZnSe/polymer/ZnO and the polymer in this work is a blend of 50 wt% Chitosan and 50 wt% polyethylene oxide (PEO). To provide I^-/I^{3-} redox couple, ammonium iodide NH_4I and some iodine crystals were added to the polymer blend solution. The polymer electrolyte film that showed highest room temperature ionic conductivity of 1.18×10^{-5} S cm^{-1} was sandwiched between the ZnSe and ZnO semiconductors. The I–V characteristics for the determination of open circuit voltage, V_{oc} and short-circuit current, I_{sc} were carried out in the dark and under illumination. The cell was illuminated with a GE EDYSON neon lamp and the effective area was 1.0 cm^2.

Introduction

Silicon has been the material of choice for photovoltaic designers because it is inexpensive and relatively well understood—and, of course, because it has properties that make it appropriate for photovoltaic applications [1, 2]. Recent advances in photovoltaic technology, however, have made other materials in combination attractive for the design of solar cells. Designers layer semiconductor materials with differing band gap energies to result in higher conversion efficiencies. Although silicon can be used as one of these layers [3], alloys combining Group II elements with Group VI elements are enticing choices because of the wide range of band gap energies they offer the designers [4]. The photovoltaic designer must maximize power by optimizing the tradeoffs between current and voltage. To maximize current, it is desirable to capture as many photons from the spectrum of solar radiation as possible. A small band gap may then be selected so that even photons with lower radiation energies can excite electrons into the conduction band. However, the small band gap results in a lower photovoltage. Additionally, the photons with higher energies will have much of their energy wasted as heat, instead of conversion into electrical energy. Alternatively, the designer can choose a higher band gap, but then will not capture any photon energy less than that band gap, resulting in a lower photocurrent and, in turn, reducing the output current of the device. Multijunction cells use a combination of semiconductor materials to more efficiently capture a larger range of photon energies. They do so without sacrificing photovoltage or creating losses of heat to the degree of single-junction cells. Multiple layer