CONTEMPORARY METALLIC MATERIALS

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Chapter 028

A Study on Double Junction Zinc Based/Polymer Thin Film Solar Cell

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Abstract: A ZnSe/polymer/ZnTe junction has been fabricated and the photovoltaic properties have been studied. The polymer was a blend of 50wt% chitosan and 50wt% polyethylene oxide (PEO). The polymer blend was complexed with ammonium iodide (NH_4I) and some iodine crystals were added to the polymer–NH_4I solution to provide I^-/I^{3-} redox couple. The ionic conductivity of the polymer electrolyte was 1.18×10^{-5} S cm^{-1} at room temperature. ZnSe and ZnTe were electrodeposited on ITO conducting glass. The polymer film was sandwiched between the ZnSe and ZnTe semiconductors to form a ZnSe/polymer electrolyte/ZnTe photovoltaic cell. The open circuit voltage (V_{oc}) of the fabricated cells ranges between 400 and 500 mV and (I_{sc}) the short circuit current between 2 and 4 μA.

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. Designs layer semiconductor materials with differing band gap energies 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.