Pengaruh Konsentrasi *Doping* dan Ketebalan Lapisan Terhadap Performa Sel Surya CdTe/CdS: Studi Simulasi PC1D

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INTISARI

Kadmium telurida merupakan bahan semikonduktor yang sangat menjanjikan untuk menjadi bahan pembuatan sel surya lapisan tipis karena *bandgap*-nya yang mendekati spektrum optimal matahari. Pada penelitian ini dianalisis mengenai pengaruh ketebalan dan konsentrasi *doping* pada performa sel surya.

Simulasi *Personal Computer One Dimensional* (PC1D) versi 5 telah dilakukan untuk menganalisis pengaruh variasi konsentrasi *doping CdTe*, ketebalan lapisan tipe-p CdTe, dan ketebalan lapisan tipe-n CdS terhadap nilai tegangan rangkaian terbuka (Voc), arus rangkaian pendek (Isc), daya maksimum (Pmax), dan *fill factor* (FF). Variasi dilakukan pada, dan pengaruh penambahan *back surface field* pada sel surya dengan ketebalan lapisan *absorber* yang rendah.

Penambahan ketebalan lapisan CdTe berpengaruh pada peningkatan nilai efisiensi, Voc, dan Isc; sedangkan pada FF nilainya hanya meningkat hingga ketebalan 1 μm. Penambahan ketebalan lapisan CdS cenderung mengurangi nilai semua parameter yang diamati. Di sisi lain konsentrasi *doping* meningkatkan parameter yang diamati walau tidak signifikan. Penambahan BSF berupa ZnTe terbukti dapat meningkatkan efisiensi sel surya dengan ketebalan lapisan *absorber* di bawah 2 μm. Optimasi parameter telah dilakukan dan diperoleh efisiensi terbaik sebesar 15,32% pada konfigurasi ketebalan CdTe 9,74 μm tanpa lapisan BSF. Pada lapisan CdTe ultra tipis didapatkan efisiensi 15,13% untuk ketebalan *absorber* 0,58 μm dengan tambahan lapisan BSF ZnTe setebal 0,4 μm.

Kata kunci: *Ketebalan CdTe, Ketebalan CdS, Konsentrasi Doping CdTe, BSF, PC1D*

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The Impact of Doping Concentration and Layer Thickness on CdTe/CdS *Solar* Cell Performance: a Study of PC1D Simulation

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ABSTRACT

Cadmium telluride is a *solar* semiconductor material that is very promising to make thin layer *solar* cells because of its bandgap close to the optimal spectrum. This study explores the effect and concentration of *doping* on the performance of *solar* cells.

Personal Computer One Dimensional (PC1D) simulation has been carried out to observe the effect of variations in several parameters of CdTe *solar* cells on the values of open circuit voltage (Voc), short circuit current (Isc), *fill factor* (FF) and maximum power (Pmax). Variations were made on the *doping* concentration, the thickness of the CdTe layer, the thickness of the CdS layer, and the addition of a back surface layer on *solar* cells with a low absorbent layer thickness.

Based on the simulation results, it was found that the addition of the CdTe layer thickness affected on increasing the efficiency value, open circuit voltage (Voc), short circuit current (Isc), while the *Fill Factor* (FF) value increases only up to a thickness of 1 μm. The addition of the CdS layer reduces the values of all observed parameters. On the other hand, the *doping* concentration increased the observed parameters although not significantly. The addition of the back surface field (BSF) in the form of ZnTe is proven to increase the efficiency of *solar* cells with an absorbent layer thickness of below 2 μm. Parameter optimization has been carried out and obtained the best efficiency of 15.32% in the configuration of 9.74 μm thick CdTe layer, CdTe doping concentration of 1.37×10^{-13}. In the ultra-thin CdTe layer, an efficiency of 15.13% was obtained for an absorbent thickness of 0.58 μm with a 0.4 μm thick ZnTe BSF layer.

Key words: *CdTe thickness, CdS thickness, doping concentration, BSF, PC1D*

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