INTISARI

Pemodelan Karakteristik Rapat Arus-Tegangan dan Distribusi Medan Listrik dalam Sel Surya Organik *Heterojunction*

Oleh

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Telah dibuat model terhadap karakteristik rapat arus-tegangan (J-V) dan distribusi medan listrik internal di dalam sel surya organic *heterojunction*. Untuk keperluan tersebut, struktur divais terdiri dari *copper phthalocyanine* (CuPc) dan 3,4,9,10-*perylenetetracarboxylic bisbenzimidazole* (PTCBI), masing-masing sebagai lapisan penghantar *hole* dan elektron. Kedua lapisan tersebut membentuk struktur heterojunction yang disisipkan di atara elektroda depan yang transparan In_2O_3 (ITO) dan elektroda belakang (Ag).

Respon fotovoltaik di bawah iluminasi pada level intensitas tertentu dimodelkan menggunakan rangkaian ekuivalen untuk model sel surya anorganik sambungan pn. Sementara itu, distribusi medan listrik optis internal dalam divais dihitung dengan menerapkan indeks bias tidak gayut panjang gelombang dan ketebalan lapisan CuPc maupun PTCBI. Kontribusi koefisien absorpsi dari lapisan CuPc maupun PTCBI terhadap distribusi medan listrik optis internal sangat diperlukan dalam modeling ini.

Sebagai hasilnya, diperoleh ketergantungan intensitas cahaya terhadap nilai-nilai dari parameter internal seperti hambatan serial R_s, hambatan shunt R_{sh}, rapat arus saturasi J_s, potensial termal V_T dan factor idealitas dioda n. Lebih dari itu, hasil perhitungan menunjukkan bahwa distribusi medan listik optis internal sangat bergantung pada ketebalan lapisan baik CuPc dan PTCBI. Hal ini bisa fahami karena ketebalan lapisan mempengaruhi refleksi balik oleh lapisan elektroda belakang (Ag). Selanjutnya, hasil-hasil ini dapat dimanfaatkan untuk melakukan optimasi sel surya organic berstruktur heterojunction di masa depan.

Kata kunci: eksiton, model sambungan pn, parameter internal, distribusi medan listrik optis internal.

ABSTRACT

Modeling of Current Density – Voltage Characteristics and Distribution of Electric Field in Heterojunction Organic Solar Cells

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Modeling of experimental current density – voltage (*J-V*) and electric field distribution in heterojunction organic solar cells has been performed. Devices consisted of a heterojunction of a copper phthalocyanine (CuPc) as a hole conductor material and 3,4,9,10-perylenetetracarboxylic bisbenzimidazole (PTCBI) as an electron conductor material sandwiched between front transparent electrode of In_2O_3 (ITO) and back electrode (Ag).

The photovoltaic response at a given illumination level is parameterized and modeled using the equivalent circuit model developed for inorganic pn-junction solar cells. Meanwhile, the internal optical electric field distribution inside the devices was calculated with the use of real indices of refraction and layer thickness of the materials. Contributions to the distribution of internal optical electric field from optical absorption spectra of CuPc and PTCBI layers were both necessary to the model.

As a result, it was obtained the dependence of illumination intensity on the values for the following internal parameters such as serial resistance R_s, shunt resistance R_{sh}, current density of saturation J_s, thermal potential V_T and ideality dioda n, respectively. In addition, the calculated internal optical electric field distribution is strongly dependent on layer thickness of both CuPc and PTCBI layers. It may be due to the effect of back reflection by the back electrode of Ag. The results on the overall photovoltaic performance are discussed and can be used in order to study the influence of the geometrical structure with respect to the efficiency of the thin film devices. In this way the performance was optimized.

Keywords: exciton, pn-junction model, internal parameters, internal optical electric field distribution.