PENGARUH KETEBALAN LAPISAN FILM TIPIS TiO_2 NANOPARTIKEL TERHADAP SIFAT OPTIK DAN LISTRIK SEL SURYA PEROVSKITE $CH_3NH_3PbI_3$

SKRIPSI

Diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana Sains
Program Studi Fisika kelompok bidang kajian Fisika Material

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FPMIPA UPI

HALAMAN PENGESAHAN

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ABSTRAK

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Sel surya perovskite merupakan sel surya yang memanfaatkan proses fotoelektrokimia dalam mengubah energi foton menjadi energi listrik. Sel surya ini merupakan salah satu alternatif sel surya yang ramah lingkungan, proses fabrikasi yang mudah, dan biaya penelitian yang rendah. Penelitian ini difokuskan pada penentuan variasi ketebalan dari lapisan film tipis TiO_2 sebagai *Electron Transport Layer* (ETL) serta pengaruhnya terhadap sifat optik dan sifat listrik pada sel surya perovskite. Ketebalan dari lapisan film tipis TiO_2 diukur menggunakan jangka sorong digital. Karakterisasi sifat optik diperoleh dari hasil absorbansi menggunakan alat *UV-Vis Spectrophotometer*, sedangkan karakterisasi untuk sifat listrik yang meliputi nilai efisiensi (η), densitas arus *short-circuit* (Jsc), tegangan *open-circuit* (Voc), dan *Fill Factor* (FF) menggunakan alat *Standard Solar Simulator 1.5 AM filter 100 mW/cm²*. Hasil yang diperoleh yaitu variasi ketebalan lapisan TiO_2 sebesar 41,75 µm, 28,50 µm, 19,00 µm, dan 10,00 µm berdasarkan laju putaran *spin coating* 3000 rpm, 4000 rpm, 5000 rpm, dan 6000 rpm selama 20 detik yang menghasilkan formulasi bahwa setiap 1 rpm dari laju putaran *spin coating* akan dihasilkan ketebalan sebesar -0,0105 + 71,95 µm. Nilai absorbansi sebesar 1,81 a.u, 1,82 a.u, 2,45 a.u, dan 2,83 a.u untuk sampel dengan masing-masing ketebalan 10 µm, 19 µm, 28,50 µm, dan 41,75 µm yang menunjukan bahwa nilai absorbansi dari sampel perovskite yang dideposisikan pada variasi lapisan TiO_2 meningkat bersamaan dengan bertambahnya ketebalan. Nilai efisiensi tertinggi dimiliki oleh sampel dengan ketebalan 10 µm sebesar $2{,}50\ x\ 10^{-7}$ % dengan nilai Jsc 0,30 x 10^{-6} mA/cm², Voc 0,0656 V, FF 23 %. Sifat listrik dari sel surya perovskite dipengaruhi oleh ketebalan lapisan TiO_2, semakin tipis lapisan TiO_2 semakin tinggi nilai efisensi yang dihasilkan.

Kata Kunci: film tipis TiO_2, ketebalan TiO_2, sel surya perovskite.

ABSTRACT

EFFECT OF THE THICKNESS OF TiO_2 NANOPARTICLE FILM LAYERS ON OPTICAL AND ELECTRICAL FEATURES OF $CH_3NH_3PbI_3$ PEROVSKITE SOLAR CELLS

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Perovskite solar cells utilize photoelectrochemical processes in converting photon energy into electrical energy. This solar cell is an alternative solar cell that is environmentally friendly, easy fabrication process, and low research costs. This research is focused on determining the thickness variation of the TiO_2 thin film layer as an Electron Transport Layer (ETL) and its effect on the optical properties and electrical properties of perovskite solar cells. The thickness of the TiO_2 thin film layer was measured using a digital Vernier caliper. Characterization of optical properties was obtained from absorbance results using a UV-Vis Spectrophotometer, while characterization for electrical properties which include short-circuit current density value (J_{sc}), Fill Factor (FF), open-circuit voltage (V_{oc}), and efficiency (η) using Standard Solar Simulator 1.5 AM filter 100 mW/cm^2. The results obtained are the variation of TiO_2 layer thickness of 41.75 µm, 28.50 µm, 19.00 µm, and 10.00 µm based on the spin coating speed of 3000 rpm, 4000 rpm, 5000 rpm, and 6000 rpm for 20 seconds which results in the formulation of every 1 rpm of spin coating resulting in a thickness of -0.0105 + 71.95 µm. The absorbance value of 1.81 a.u, 1.82 a.u, 2.45 a.u, and 2.83 a.u for samples with thicknesses of 10 µm, 19 µm, 28.50 µm, and 41.75 µm respectively which shows that the absorbance value of the perovskite sample deposited on the TiO_2 layer variation increases with increasing thickness. The highest efficiency value is owned by the sample with TiO_2 layer thickness at 10 µm of 2.50×10^{-7} % with J_{sc} 0.30×10^{-6} mA/cm^2, V_{oc} 0.0656 V, FF 23 %. The electrical properties of perovskite solar cells are influenced by the thickness of the TiO_2 layer, the thinner the TiO_2 layer the higher the resulting efficiency value.

Keywords: perovskite solar cell, TiO_2 thin film, TiO_2 thickness.

DAFTAR ISI

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