PENGARUH KETEBALAN LAPISAN $CsPbIBr_2$ TERHADAP KINERJA SEL SURYA PEROVSKITE

SKRIPSI

Diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains
Program Studi Fisika Kelompok Bidang Kajian Fisika Material

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Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains Program Studi Fisika pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

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ABSTRAK

PENGARUH KETEBALAN LAPISAN $CsPbIBr_2$ TERHADAP KINERJA SEL SURYA PEROVSKITE

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Sel surya perovskite memiliki prospek besar sebagai teknologi fotovoltaik generasi baru karena efisiensi tinggi dan proses fabrikasi sederhana, namun performanya masih dipengaruhi oleh stabilitas serta optimasi lapisan aktif. Penelitian ini bertujuan untuk menganalisis pengaruh variasi ketebalan lapisan perovskite $CsPbIBr_2$ terhadap sifat optik dan kinerja sel surya. Fabrikasi perangkat dilakukan dengan struktur FTO/TiO_2/$CsPbIBr_2$/Spiro-OMeTAD/*Copper Tape*. Variasi ketebalan diperoleh melalui metode *layer by layer*. Karakterisasi dilakukan menggunakan spektroskopi UV-Vis, pengukuran arus-tegangan (I–V), serta *Scanning Electron Microscopy* (SEM). Hasil UV-Vis menunjukkan bahwa peningkatan ketebalan lapisan meningkatkan absorbansi pada hampir seluruh panjang gelombang, dengan puncak serapan 300–350 nm. Kinerja sel surya terbaik diperoleh pada ketebalan 3 lapis dengan *power conversion efficiency* (PCE) 2,407 $\times 10^{-5}$ %, sementara nilai *short-circuit current density* (Jsc) tertinggi terdapat pada ketebalan 5 lapis sebesar 0,026 mA/cm^2. Ketebalan berlebih (7 dan 9 lapis) menurunkan performa akibat jarak transport muatan lebih panjang dan peluang rekombinasi lebih tinggi. Analisis SEM mengonfirmasi bahwa film 3 lapis memiliki morfologi kristal vertikal dengan ketebalan sekitar 250 nm, yang mendukung transport muatan dan mengurangi rekombinasi non-radiatif.

Kata kunci: $CsPbIBr_2$, Ketebalan lapisan perovskite, Sel surya perovskite

ABSTRACT

THE EFFECT OF $CsPbIBr_2$ LAYER THICKNESS ON PERFORMANCE OF PEROVSKITE SOLAR CELLS

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Perovskite solar cells have attracted considerable attention as a next-generation photovoltaic technology due to their high efficiency and simple fabrication process. However, their performance is strongly affected by stability issues and optimization of the active layer structure. This study aims to investigate the effect of perovskite $CsPbIBr_2$ layer thickness on the optical properties and performance of the solar cell. The device was fabricated with the structure FTO/TiO_2/$CsPbIBr_2$/Spiro-OMeTAD/Copper Tape. The thickness variation was controlled using the layer by layer method. Characterization techniques included UV-Vis spectroscopy, current–voltage (I–V) measurements, and Scanning Electron Microscopy (SEM). UV-Vis results showed that increasing film thickness enhanced the absorbance across most wavelengths, with a strong absorption peak observed at 300–350 nm. The best photovoltaic performance was obtained at 3 layers, yielding a power conversion efficiency (PCE) of 2.407×10^{-5} %, while the highest short-circuit current density (Jsc) of 0.026 mA/cm² was observed at 5 layers. Excessive thicknesses (7 and 9 layers) led to performance degradation due to longer carrier transport distances and higher recombination probability. SEM analysis confirmed that the 3-layer film had a vertical crystal orientation with ~250 nm thickness, supporting efficient charge transport and reducing non-radiative recombination.

Keyword*: $CsPbIBr_2$, Perovskite layer thickness, Perovskite solar cell*

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