

PREPARASI LAPIS TIPIS METILAMONIUMTIMBAL(II) IODIDA PADA LAPIS TIPIS TITANIA UNTUK SEL SURYA PEROVSKIT

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ABSTRAK

Preparasi lapis tipis metilamoniumtimbal(II) iodida pada lapis tipis titania mesopori ($\text{TiO}_2\text{-m}$) untuk sel surya perovskit telah dilakukan. Penelitian ini bertujuan untuk mengkaji pengaruh suhu sintering lapis tipis TiO_2 mesopori terhadap kristalinitas dan ukuran *grain* perovskit serta kinerja sebagai sel surya perovskit. Penelitian ini diawali dengan sintesis serbuk TiO_2 mesopori, preparasi lapis tipis $\text{TiO}_2\text{-m}$ dengan teknik *slip casting* dan kajian variasi suhu sintering lapis tipis $\text{TiO}_2\text{-m}$ dengan suhu 400, 500, dan 600 °C. Metode deposisi bertahap digunakan dalam preparasi lapis tipis metilamoniumtimbal(II) iodida ($\text{CH}_3\text{NH}_3\text{PbI}_3$) pada lapis tipis $\text{TiO}_2\text{-m}$ dengan menggunakan prekursor $\text{CH}_3\text{NH}_3\text{I}$ dan PbI_2 (1:1) dalam pelarut DMSO. Konstruksi sel surya dilakukan dengan model *solid state sensitized solar cell* dengan Spiro-OMeTAD sebagai lapisan pengangkut *hole* dan logam Ag sebagai elektroda lawan. Karakterisasi dilakukan dengan *Scanning Electron Microscope* (SEM), *Atomic Force Microscopy* (AFM), *X-Ray Diffraction* (XRD) dan uji I-V (arus-voltase).

Hasil penelitian menunjukkan bahwa lapis tipis metilamoniumtimbal(II) iodida dapat diperoleh pada semua lapis tipis titania mesopori dengan variasi suhu sintering. Suhu sintering lapis tipis $\text{TiO}_2\text{-m}$ berpengaruh terhadap kristalinitas dan ukuran kristal. Semakin tinggi suhu sintering maka kristalinitas lapis tipis $\text{TiO}_2\text{-m}$ semakin meningkat dan ukuran kristal semakin besar. Ukuran kristal lapis tipis $\text{TiO}_2\text{-m}$ pada variasi suhu sintering 400, 500, dan 600 °C berturut-turut yaitu 10,50; 12,24; dan 21,09 nm. Hasil XRD lapis tipis perovskit menunjukkan kristalinitas tertinggi diperoleh pada suhu sintering 500 °C, dan ukuran *grain* rerata perovskit terbesar diperoleh pada suhu 600 °C sebesar 1,38 μm . Ukuran rerata *grain* perovskit suhu sintering 400, dan 500 °C berturut-turut yaitu 0,82; dan 1,25 μm . Lapisan perovskit dengan keseragaman tinggi, ukuran *grain* besar dan kristalinitas tinggi diperoleh pada suhu sintering $\text{TiO}_2\text{-m}$ 500 °C sehingga menghasilkan efisiensi tertinggi sebesar 4,14% sedangkan efisiensi sel surya perovskit metilamoniumtimbal(II) iodida pada lapis tipis titania mesopori ($\text{TiO}_2\text{-m}$) suhu sintering 400 dan 600 °C yaitu 3,04% dan 2,31%.

Kata kunci: $\text{CH}_3\text{NH}_3\text{PbI}_3$, TiO_2 mesopori, *grain*, deposisi bertahap, sel surya perovskit

PREPARATION OF METHYLAMMONIUMLEAD(II) IODIDE THIN FILM ON TITANIA THIN FILM FOR PEROVSKITE SOLAR CELL

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ABSTRACT

Preparation of a methylammoniumlead (II) iodide thin film on a mesoporous titania ($\text{TiO}_2\text{-m}$) thin film for perovskite solar cells was carried out. This study also aims to examine the effect of sintering temperature of mesoporous TiO_2 thin film on the crystallinity and size of perovskite grain, as well as the performance of perovskite solar cells. This research was performed by synthesizing mesoporous TiO_2 powder, preparing $\text{TiO}_2\text{-m}$ thin film using slip casting technique and studying the sintering temperature of $\text{TiO}_2\text{-m}$ thin films at temperatures of 400, 500, and 600 °C. Two steps deposition was used in the preparation of the thin film of methylammoniumlead(II) iodide ($\text{CH}_3\text{NH}_3\text{PbI}_3$) on $\text{TiO}_2\text{-m}$ thin film using $\text{CH}_3\text{NH}_3\text{I}$ and PbI_2 (1: 1) precursors in DMSO solvents. Solar cell construction was carried out using a solid state sensitized solar cell with Spiro-OMeTAD as a hole transporting material and Ag metal as the counter electrode. Film characterization was carried out by Scanning Electron Microscope (SEM), Atomic Force Microscopy (AFM), X-Ray Diffraction (XRD) and I-V test (current-voltage).

The results showed that the thin layer of methylammoniumlead(II) iodide can be obtained at all mesoporous titania ($\text{TiO}_2\text{-m}$) thin films with sintering temperature variations. The sintering temperature of $\text{TiO}_2\text{-m}$ thin layer had an effect on crystallinity and crystal size. The higher the sintering temperature, the crystallinity of the $\text{TiO}_2\text{-m}$ thin layer increased and the crystal size. The crystalline size of $\text{TiO}_2\text{-m}$ thin films at various sintering temperatures of 400, 500, and 600 °C were 10.50; 12,24; and 21.09 nm, respectively. The XRD results of perovskite thin film showed the highest crystallinity obtained at sintering temperature of 500 °C, and the largest average grain size of perovskite was obtained at 600 °C at 1.38 μm . The average size of perovskite grain sintering temperature at 400 and 500 °C were 0.82; and 1.25 μm , respectively. The perovskite layer with highest homogeneity, large grain size and high crystallinity was obtained at the sintering temperature of $\text{TiO}_2\text{-m}$ 500 °C resulting in the highest efficiency of 4.14% while the efficiency of perovskite solar cells in thin films of methylammoniumlead(II) iodide prepared on titania ($\text{TiO}_2\text{-m}$) thin films sintered at 400 and 600 °C were 3.04 and 2.31%, respectively.

Keywords: $\text{CH}_3\text{NH}_3\text{PbI}_3$, mesoporous titania, grain, sequential deposition, perovskite solar cell