UNIVERSITI TEKNOLOGI MARA

ELECTRICAL PROPERTIES OF NANOSTRUCTURED TIO_2 THIN FILM FOR ORGANIC SOLAR CELLS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

The deposition and characterization of nanostructured titanium dioxide (Ti02) thin film was conducted in order to observe the compatibility of the optimized TiC>2 thin film with MEH-PPV for organic solar cell. In this work, there are the TiC>2 layers namely seed layer and active layer and the MEH-PPV which in the end of the research will be Ti02/MEH-PPV solar cell. The seed layer of TiC>2 nanostructured thin film was deposited by dip coating method in 3 layer, it has the conductivity value of 96 S/m. This seed layer film has high transmittance value of 87.6% at 450 nm wavelength to make sure most of the photon from sun light reach the active layer and thus maximized the energy yield from the solar cell. Then the nanostructured TiC>2 active layer were deposited by spin coating method. There are four parameters introduced starting with precursor concentration, spin speed effect, annealing temperature and film thickness by layer deposition. These parameters were carried out to optimize the conductivity of the nanostructured T iC > 2 thin film. The precursor concentration were varied from 0.01 - 0.14 wt.%, the 0.01 wt.% were the best by having the conductivity of 0.177 nS/m with the lowest roughness of 69 nm. The absorbance value for 0.01 wt.% concentration is 2.4% at 320 nm wavelength while the reflectance value is 10.75%. Whereas for spin speed effect, it was varied from as deposited to 3000 rpm and 1000 rpm were the best since it has a smooth and uniform surface and it is agreed by the structural properties of FESEM morphology and AFM topology that it have the lowest average value of roughness R_a 153.6 nm with the highest absorbance value of 1.7% and conductivity value were at 0.146 mS/m. Then for the annealing effect, the temperature were varied from 400 - to 500°C where the conductivity trend is increasing to 0.610458 nS/m at 450°C then decreases from 475°C onwards, by having the highest conductivity value 450°C film were the best. The surface roughness of the 450°C annealed film was 2.54 nm which indicated that it have an even and uniform surface. Then this nanostructured TiC>2 thin film was continued for the final parameter, the effect of film thickness by layer deposition in 1 - 6 layers. The conductivity at 3 layer depositions shows an increasing trend of 3.9098 nS/m in which the 4 to 6^X layer's conductivity was decreasing. Inconjuction with having the highest conductivity 3 layer film deposition were the best film. This 3 layer thin film have the intermediate roughness of 163 nm and number of grain boundary of 252 and also for its transmittance value of 35%, but by having the highest conductivity this film were chosen to be use in the fabrication of organic solar cell. Whereas for the organic part, the MEH-PPV concentration were varied from 0.25 - 2.00 mg/ml, and the optimum concentration were 0.5 mg/ml where the absorption coefficient is the highest and even though the roughness is not the lowest but the image of AFM shows a smooth surface.With all these information above the organic solar cell were fabricated by the optimum sample and the results are as follows, the density of J_{sc} = 0.354822 raA/cm , open circuit voltage of V_{oc} = 0.412423V, a fill factor of 0.257373 and a power conversion efficiency of n= 0.037663%.

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