Characteristics of carbon pyrolyzed from table sugar and sucrose for pt-less dssc counter electrode

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Abstrak

Platinum is the most effective counter electrode for use in dye-sensitized solar cells (DSSC). However, as platinum is very expensive, its price impedes its broad use as a DSSC counter electrode. As an alternative, carbon has been used for this purpose. In this study, carbon has been successfully pyrolyzed from the precursors of table sugar and sucrose through a chemical process, i.e. the dehydration of the precursors with sulfate acid followed by a pyrolysis process, and used as Pt-less counter electrode in a DSSC device. The as-synthesized carbon was characterized using X-ray diffraction (XRD) to obtain crystal structure information and a scanning electron microscope (SEM) equipped with energy dispersive X-ray spectroscopy (EDX) was employed to carry out morphological and compositional examination. The material activity and performance of the counter electrode in the DSSC device were analyzed using a semiconductor parameter analyzer through current–voltage characteristic curves (I-V). The results show that the precursors of table sugar without the addition of a metal catalyst and with initial heat treatment at 300°C for 1 hour, and of sucrose with a catalyst could produce carbon with a particle size of around 600–900 nm. The I-V curve characteristic of the DSSC device assembled using carbon produced from sucrose as a counter electrode resulted in a power conversion efficiency (PCE) of only 0.041%, whereas the DSSC device assembled using carbon produced from table sugar as a counter electrode exhibited a good performance with a PCE of 3.239%, almost equivalent to that of platinum paste with a PCE of 4.024%. This result is promising in terms of using a cheap source of carbon for the Pt-less counter electrode.