Solar-energy driven deposition of tiny rod shaped Sn catalyst for electrochemical CO_2 reduction

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Carbon dioxide (CO_2) is one of the largest contributors to global warming effect. In order to reduce its concentration from the atmosphere, reduction of CO_2 is considered more attractive than CO_2 capture and storage (CCS) due to its various advantages such as i) depletion of CO_2 from the atmosphere, ii) generation of fuels, and iii) renewable energy storage. Electrochemical reduction of CO_2 is a promising technique of current interest for the production of sustainable value added chemicals [1-2]. The existing efforts have been mainly focused on the improvement of electrocatalysts for a highly selective single product yield [3].

Herein, we investigated a new process for the preparation of rod shaped tin catalyst by the solar-energy driven deposition method. The catalyst was prepared by applying electrical energy generated from a typical solar panel between the copper foil and graphite plates in a tin chloride dehydrate electrolyte solution. The deposited powder was then removed from the graphite plate in pure water and dried at 80^{o}C to obtain the resulting Sn catalyst powder. The catalyst powder was analyzed using SEM with a formation of tiny rod shaped Sn as shown in Fig 1.

In order to evaluate the feature of catalyst towards electrochemical reduction of CO_2, the tin catalyst-coated graphite plate was used as the electrode [4]. The tin coated electrode showed the selective conversion of CO_2 to HCOOH in the pure water. The effect of catalyst towards the HCOOH formation clearly indicated that the prepared catalyst was able to actively reduce the CO_2 to the products in this system. The reaction at 1.8 V (vs. Ag/AgCl) showed that a steady increase in the production of HCOOH was observed with the reaction time in Fig 2. A maximum production yield of 0.69 mmol was observed after 2.5 hr reaction. The present work shows the innovative way of catalyst synthesis and its use in the CO_2 reduction for our future sustainable energy applications.

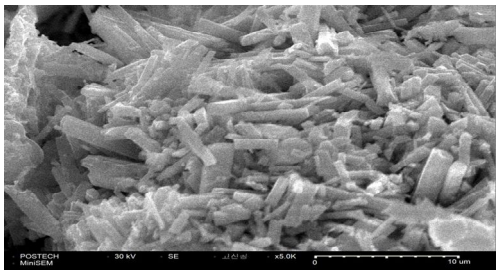

Fig 1. SEM image of rod shaped Sn catalyst.

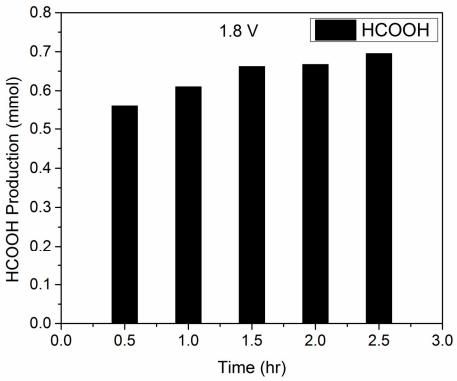

Fig 2. Production of HCOOH vs. reaction time at 1.8 V (vs. Ag/AgCl).

Acknowledgements

This work was supported by National Research Foundation of Korea (NRF) grant funded the Korea government (MSIP) (No. 2014R1A2A1A11052414,Mid-career Researcher Program) and C1 Gas Refinery Program through the NRF funded by the Korea government (MSIP) (No. 2016M3D3A1A01913567).

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