Insight into Improving Energy Efficiency of Electrochemical CO₂ Reduction to Formate in Divided H-type Cell

Rui Zhang, Luyu Shao, Jiajia Wu, Yajin Chen, Weixin Lv*, Wei Wang*

School of Chemistry and Chemical Engineering, Yancheng Institute of Technology, Yancheng 224051, China

*E-mail: weixin841230@126.com (W.X. Lv), wangw@ycit.edu.cn (W. Wang).

doi: 10.20964/2021.03.39

Received: 2 November 2020 / Accepted: 23 December 2020 / Published: 31 January 2021

The conversion of carbon dioxide (CO₂) into formate by the intermittent generation of renewable energy is of great interest for many applications. Most studies have so far focused on how to improve the faradaic efficiency but ignored the importance of energy efficiency. In this study, the electrochemical reduction of CO₂ (ERC) was carried out in a divided H-type electrolyzer. The improvement of energy efficiency was studied in the context of three aspects: (1) contrasting the cathodic catalysts, *i.e.*, traditional Sn foil with highly active nano-Bi (produced in situ by reduction from nano-Bi₂O₃), (2) comparing anodic catalysts, *i.e.*, traditional Pt plate and the as-prepared Ir/C, and (3) contrasting anodic electrolytes, *i.e.*, aqueous solutions of KHCO₃ and KOH. The energy efficiency of the ERC to formate can reach 38.2% with the r-Bi₂O₃ cathodic catalyst, and Ir/C anodic catalyst were used in 1.0 M KOH anolyte, at a low cell potential (2.06 V). This work concluded that KOH anolyte is more suitable for the ERC to formate. Furthermore, the method of calculating the energy efficiency for the ERC to formate was also systematically reviewed.

Keywords: cathodic catalyst, anodic catalyst, anolyte, energy efficiency, H-type electrolyzer

[FULL TEXT](#)

© 2021 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).