Enhancing biohydrogen production from sugar industry effluent by metal oxide coatings on nickel foam cathode in Microbial Electrolysis Cell

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Abstract

Development of low cost cathode materials is one of the crucial challenge in Microbial Electrolysis Cell (MEC) for hydrogen production[1,2]. In this study, MEC hydrogen production through various catalyst coatings on Nickel foam (NF) template cathode was investigated using sugar industry effluent. NF has proved a better performance than other cathodes in dual chamber MEC using sugar industry effluents[3]. Various catalysts are of oxides of Nickel and Cobalt synthesised using simple precipitation and calcination techniques. The hydrogen evolution performance of Nickel Oxide/ Nickel foam and Cobalt oxide/Nickel Foam was conducted in MECs which were significantly superior to NF. Electrochemical Characterization were conducted on the three cathodes and the stability of the cathode coatings were also studied. Similar to LSV trends, current density and hydrogen production rate were obtained. At an applied voltage of 1.0 V, the maximum hydrogen production rate (HPR) was achieved in MEC with NiO/NF, nearly twice than NF and 1.12 times higher than other metal oxide cathode. The MEC performance using the three cathodes based on the production of hydrogen, coloumbic efficiency, hydrogen recoveries and COD removal efficiency were also in the order as same as the HPR. The hydrogen gas collected from the MEC was confirmed of high purity using GC analysis. These results demonstrate the high-efficient and low cost cathodes materials for biohydrogen production in MECs.

References:

[1] Tenca A, Cusick RD, Schievano A, Oberti R, Logan BE. Evaluation of low cost cathode materials for treatment of industrial and food processing wastewater using microbial electrolysis cells. Int J Hydrogen Energy 2013;38:1859–65.

[2] Selembo PA, Merrill MD, Logan BE. The use of stainless steel and nickel alloys as low-cost cathodes in microbial electrolysis cells. *J Power Sources* 2009;190:271–8.

[3] Jayabalan T, Matheswaran M, Mohammed SN. Biohydrogen production from sugar industry effluents using nickel based electrode materials in microbial electrolysis cell. Int J Hydrogen Energy 2018:1–8.*Article in press* doi:10.1016/j.ijhydene.2018.09.219.

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