Environmental Science & Technology Letters

Letter

Previous Article | Table of Contents

Self-Supplied Ammonium Bicarbonate Draw Solute for Achieving Wastewater Treatment and Recovery in a Microbial Electrolysis Cell-Forward Osmosis-Coupled System

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Department of Civil and Environmental Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, United States

Environ. Sci. Technol. Lett., **2014**, *1* (10), pp 437–441
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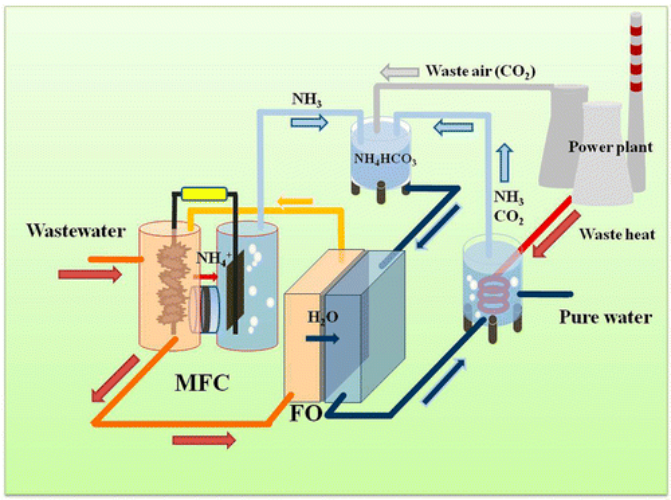
Abstract



This study has presented a proof-of-concept system for the self-sustained supply of ammonium-based draw solute for wastewater treatment through coupling a microbial electrolysis cell (MEC) and forward osmosis (FO). The MEC produced an ammonium bicarbonate draw solute via recovering ammonia from a synthetic organic solution, which was then applied in the FO for extracting water from the MEC anode effluent. The recovered ammonium could reach a concentration of 0.86 mol L^{-1}, and with this draw solution, the FO extracted 50.1 ± 1.7% of the

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Metrics

Title: Integrated experimental and modeling evaluation of energy consumption for ammonia recovery in bioelectrochemical systems

Author: Mohan Qin,Ying Liu,Shuai Luo,Rui Qiao,Zhen He

Publication: Chemical Engineering Journal

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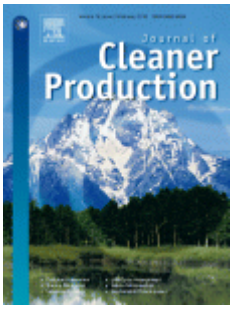

Title:	Ammonium removal from synthetic wastewater promoted by current generation and water flux in an osmotic microbial fuel cell
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Publication:	Journal of Cleaner Production
Publisher:	Elsevier
Date:	15 April 2017

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Nanoparticulate $Ni(OH)_2$ Films Synthesized from Macrocyclic Nickel(II) Cyclam for Hydrogen Production in Microbial Electrolysis Cells

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Author Affiliations

Abstract

Hydrogen production in microbial electrolysis cells (MECs) is a promising approach for energy harvesting from wastewater. The kinetic barriers toward proton reduction necessitate the use of catalysts to drive hydrogen formation at appreciable rates and low applied potentials. Towards this end, cost effective alternatives to platinum catalysts are of paramount interest. In this study, $Ni(OH)_2$ films were synthesized by electrophoretic deposition from a Ni(II)cyclam precursor solution at varying concentrations (6 mM, 15 mM, and 23 mM). The films were characterized by scanning electron microscopy and X-ray photo-electron spectroscopy to confirm the deposition of $Ni(OH)_2$. The $Ni(OH)_2$-modified electrodes were then examined by both traditional electrochemical measurements and in an MEC for hydrogen production. Tafel analysis indicates an exchange current density of ~0.36 mA cm^{-2} with a Tafel slope of ~120 mV $decade^{-1}$ consistent with a rate determining proton adsoprtion step. The hydrogen production rates increased with increasing Ni(II)cyclam concentration in the precursor solution, with the 23 mM-derived film exhibiting a rate comparable to that of a Pt-based catalyst in MEC tests.

Keywords

catalysis **earth abundant** **hydrogen production** **microbial fuel cells** **nickel hydroxide**

Footnotes

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Title: Effects of current generation and electrolyte pH on reverse salt flux across thin film composite membrane in osmotic microbial fuel cells

Author: Mohan Qin,Ibrahim M. Abu-Reesh,Zhen He

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Publisher: Elsevier

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Article | OPEN

Understanding Ammonium Transport in Bioelectrochemical Systems towards its Recovery

Ying Liu, Mohan Qin, Shuai Luo, Zhen He & Rui Qiao

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Abstract

We report an integrated experimental and simulation study of ammonia recovery using microbial electrolysis cells (MECs). The transport of various species during the batch-mode operation of an MEC was examined experimentally and the results were used to validate the mathematical model for such an operation. It was found that, while the generated electrical current through the system tends to acidify (or basify) the anolyte (or catholyte), their effects are buffered by a cascade of chemical groups such as the NH_3/NH_4^+ group, leading to relatively stable pH values in both anolyte and catholyte. The transport of NH_4^+ ions accounts for ~90% of the total current, thus quantitatively confirming that the NH_4^+ ions serve as effective proton shuttles during MEC operations. Analysis further indicated that, because of the Donnan equilibrium at cation exchange membrane-anolyte/catholyte interfaces, the Na^+ ion in the anolyte actually facilitates the transport of NH_4^+ ions during the early stage of a batch cycle and they compete with the NH_4^+ ions weakly at later time. These insights, along with a new and simple method for predicting the strength of ammonia diffusion from the catholyte toward the anolyte, will help effective design and operation of bioeletrochemical system-based ammonia recovery systems.

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