A Performance Evaluation of a Microchannel Reactor for the Production of Hydrogen from Formic Acid for Electrochemical Energy Applications

Isabella M. Ndlovu¹, Raymond C. Everson¹, Steven Chiuta¹, Hein W.J.P. Neomagus¹,
Henrietta W. Langmi², Jianwei Ren², Nicolaas Engelbrecht¹ and Dmitri G. Bessarabov^{1,*}

¹ HySA Infrastructure Centre of Competence, North-West University, Faculty of Engineering, Private Bag X6001, Potchefstroom, 2520, South Africa

² HySA Infrastructure Centre of Competence, Materials Science and Manufacturing, Council for Scientific and Industrial Research (CSIR), PO Box 395, Pretoria, 0001, South Africa

*E-mail: Dmitri.Bessarabov@nwu.ac.za

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An experimental evaluation of a microchannel reactor was completed to assess the reactor performance for the catalytic decomposition of vaporised formic acid (FA) for H₂ production. Initially, X-ray powder diffraction (XRD), elemental mapping using SEM-EDS and BET surface area measurements were done to characterise the commercial Au/Al₂O₃ catalyst. The reactor was evaluated using pure (99.99%) and diluted (50/50 vol.%) FA at reactor temperatures of 250–350°C and inlet vapour flow rates of 12–48 mL.min⁻¹. Satisfactory reactor performance was demonstrated at 350°C as near-equilibrium FA conversion (>98%) was obtained for all flow rates investigated. The best operating point was identified as 350°C and 48 mL.min⁻¹ (pure FA feed) with a H₂ yield of 68.7%. At these conditions the reactor performed well in comparison to conventional systems, achieving a H₂ production rate of 11.8 NL.g_{cat}⁻¹.h⁻¹. This paper therefore highlights important considerations for ongoing design and development of microchannel reactors for the decomposition of FA for H₂ production.

Keywords: Formic acid decomposition; hydrogen production; microchannel reactor; fuel cell application; Au/Al₂O₃ catalyst

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