Int. J. Electrochem. Sci., 11 **(2016)** 9254 – 9264

International Journal of ELECTROCHEMICAL SCIENCE
www.electrochemsci.org

Short Communication

An Anionic Non-Aqueous Single Substance Redox Flow Battery Based on Triiodide

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doi: 10.20964/2016.11.14

Received: 28 June 2016 / *Accepted:* 29 August 2016 / *Published:* 10 October 2016

A single-substance redox-flow battery (RFB) based on the iodide/triiodide and triiodide/iodine redox couples has been investigated. Stable charge-discharge curves were recorded under ambient air in a stirred PTFE batch cell. Current efficiencies were > 90 %. Current densities were kept low (33 µA cm^{-2}) due to high resistance (5.8 kΩ cm^2) of the cation exchange membrane used. It is shown theoretically, that the open voltage potential E_{OC} of redox flow batteries with complex stoichiometry is concentration dependent. For comproportionation electrolytes, the E_{OC} increases with bulk concentration, which is proved experimentally for the $I^-/I_3^-/I_2$ system. The open cell voltage ranged from 0.36 V to 0.58 V for 1–80 mM solutions. The formal potential difference $\Delta E^{0'}$ was determined by cyclic voltammetry (0.655 V) and open cell voltages (0.69 V), respectively. Interestingly, the calculation of $\Delta E^{0'}$ required the evaluation of the open cell voltage at a state of charge of the inverse of the golden number. This is a consequence of the "golden" stoichiometric factors of the iodide/iodine comproportionation.
To the authors' knowledge, this is the first report of a non-aqueous redox-flow battery utilizing an anionic catholyte and thus also the first where only anionic or neutral redox active species are employed.

Keywords: redox-flow battery; non-aqueous; triiodide; comproportionation; stoichiometry

FULL TEXT