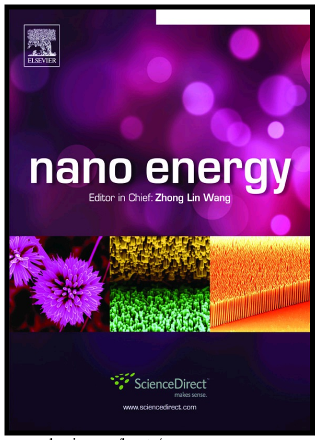
Author's Accepted Manuscript



www.elsevier.com/locate/nanoenergy

Wide bandgap oxides for low-temperature single-layered nanocomposite fuel cell

Muhammad Imran Asghar, Sami Jouttijärvi, Riina Jokiranta, Anna-Maija Valtavirta, Peter D. Lund

PII: S2211-2855(18)30630-X
DOI: https://doi.org/10.1016/j.nanoen.2018.08.070
Reference: NANOEN3000

To appear in: *Nano Energy*

Received date: 12 July 2018
Revised date: 30 August 2018
Accepted date: 30 August 2018

Cite this article as: Muhammad Imran Asghar, Sami Jouttijärvi, Riina Jokiranta, Anna-Maija Valtavirta and Peter D. Lund, Wide bandgap oxides for low-temperature single-layered nanocomposite fuel cell, *Nano Energy,* https://doi.org/10.1016/j.nanoen.2018.08.070

Wide bandgap oxides for low-temperature single-layered nanocomposite fuel cell

Muhammad Imran Asghar, Sami Jouttijärvi, Riina Jokiranta, Anna-Maija Valtavirta, Peter D. Lund*

New Energy Technologies Group, Department of Applied Physics, Aalto University School of Science, P. O. Box 15100, FI-00076 Aalto, Espoo, Finland

*Corresponding author. Professor Peter D. Lund peter.lund@aalto.fi

Abstract

A composite of wide bandgap lithium-nickel-zinc-oxide (LNZ) and gadolinium-doped-cerium-oxide (GDC) was systematically analyzed for a low-temperature nanocomposite fuel cell in a so-called single-component configuration in which the electrodes and electrolyte form a homogenous mixture. We found that the operational principle of a single-layer fuel cell can be explained by electronic blocking by the oxide mixture with almost insulator-like properties in the operating voltage regime of the fuel cell, which will prevent short-circuiting, and by its catalytic properties that drive the fuel cell HOR and ORR reactions. The resistance to charge transport and leakage currents are dominant performance limiting factors of the single-component fuel cell. A test cell with Au as current collector reached a power density of 357 mWcm^{-2} at 550^{o}C. Changing the current collector to a $Ni_{0.8}Co_{0.15}Al_{0.05}LiO_2$ (NCAL) coated Ni foam produced 801 mWcm^{-2}, explained by better catalytic properties. However, utilizing NCAL coated Ni foam may actually turn the 1-layer fuel cell device into a traditional 3-layer (anode-electrolyte-cathode) structure. This work will help in improving the understanding of the underlying mechanisms of a single-layer fuel cell device important to further develop this potential energy technology.