Accepted Manuscript

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PII: S0013-4686(18)30408-0

DOI: 10.1016/j.electacta.2018.02.104

Reference: EA 31299

To appear in: *Electrochimica Acta*

Received Date: 24 October 2017

Revised Date: 14 February 2018

Accepted Date: 20 February 2018

Please cite this article as: A. Fetyan, G.A. El-Nagar, I. Derr, P. Kubella, H. Dau, C. Roth, A neodymium oxide nanoparticle-doped carbon felt as promising electrode for vanadium redox flow batteries, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2018.02.104.

A Neodymium Oxide Nanoparticle-Doped Carbon Felt as Promising Electrode for Vanadium Redox Flow Batteries

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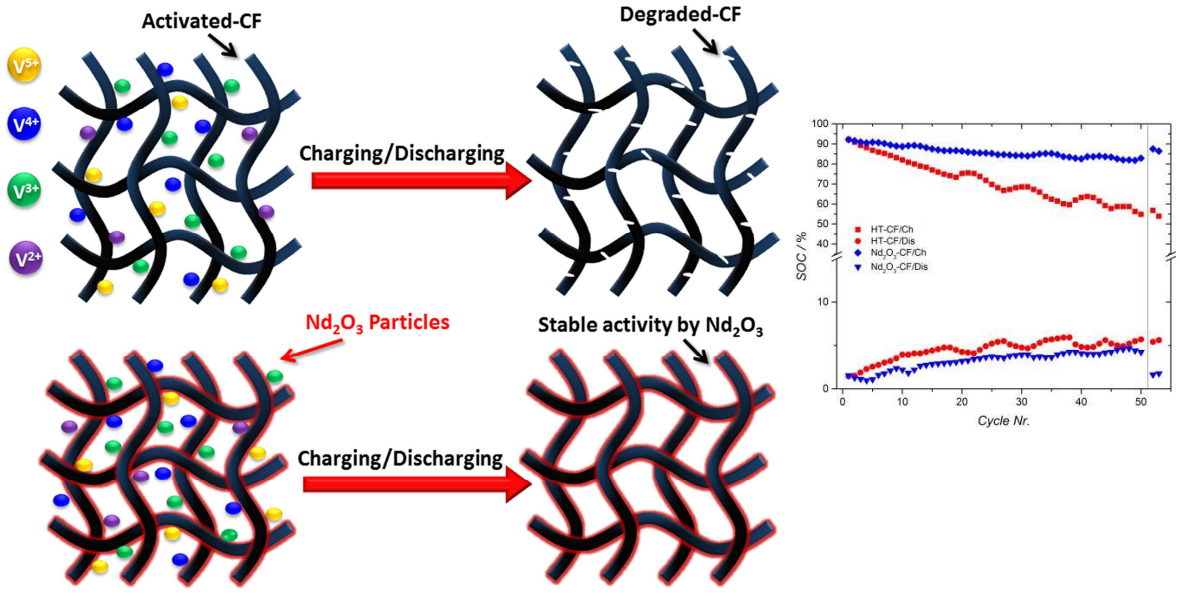
Abstract

Neodymium oxide (Nd_2O_3) nanoparticles were chemically embedded on a state-of-the art carbon felt (CF) by a precipitation method in non-aqueous solution. Different Nd_2O_3 loadings were chosen and the obtained electrocatalyst-loaded felts tested for application as electrode in all-vanadium redox flow batteries. Cyclic voltammetry (CV) studies confirmed that Nd_2O_3 has a catalytic effect towards both redox couples, V^{4+}/V^{5+} at the positive and V^{2+}/V^{3+} at the negative side. Scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX) and X-ray diffraction (XRD) demonstrated only minor particle agglomeration and high dispersion of the particles on the fibres. Charge/discharge profiles revealed an enhanced performance with higher discharge capacity and higher energy efficiency for the modified felts when compared to a thermally activated CF. For instance, after 50 consecutive charge/discharge cycles the energy efficiency of the Nd_2O_3 modified carbon felt (Nd_2O_3-CF) was reduced only by 3% compared to a 12% irreversible loss observed for the thermally activated CF. After exchanging the electrolyte after 50 cycles, the felts retained their original performance indicating that less degradation occurred in the modified felts than in the industrial standard and that they maintained their oxygen-donating functionalities on the surface as compared to thermally activated CF.



Keywords: Neodymium Oxide, Carbon Felt, Degradation, Electrode, Redox Flow Batteries.

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