Accepted Manuscript

Using an in-plane geometry in Hebb-Wagner measurements to avoid errors from electrode overpotential

Gyeong Duk Nam, Jou-Hyeon Ahn, Jong Hoon Joo

PII: S0013-4686(17)32616-6

DOI: 10.1016/j.electacta.2017.12.056

Reference: EA 30844

To appear in: *Electrochimica Acta*

Received Date: 3 October 2017

Revised Date: 6 December 2017

Accepted Date: 8 December 2017

Please cite this article as: G.D. Nam, J.-H. Ahn, J.H. Joo, Using an in-plane geometry in Hebb-Wagner measurements to avoid errors from electrode overpotential, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2017.12.056.

Using an in-plane geometry in Hebb-Wagner measurements to avoid errors from electrode overpotential

Gyeong Duk Nam[a], Jou-Hyeon Ahn[b] Jong Hoon Joo[a*]

[a]Department of Advanced Material Engineering, Chungbuk National University, 1 Chungdae-ro Seowon-gu, Cheongju, Chungbuk 28644, Republic of Korea

[b]Department of Materials Engineering and Convergence Technology & RIGET, Gyeongsang National University, 501, Jinju-daero, Jinju-si, Gyeongsangnam-do, Republic of Korea

*Corresponding author, E-mail: jhjoo@chungbuk.ac.kr, jonghoonjoo@gmail.com (Jong Hoon Joo), Phone: +82-43-261-2415, Fax: 82-43-271-3222;

Abstract

A new approach has been proposed to overcome the electrode overpotential problem in the two-probe Hebb-Wagner polarization cell by dramatically increasing the shape factor of the polarization cell. To accurately estimate the electronic conductivity, a thick-film of gadolinium-doped ceria (GDC) has been fabricated using the tape casting technique, which sharply increases the shape factor of the sample. The bulk resistance of this thick-film cell is about two orders of magnitude higher than that of a bulk cell. In contrast to the bulk resistance, the electrode resistance remains nearly constant. Thus, the contribution of the electrode overpotential to the total resistance can be neglected in an in-plane geometry. The measured *n*-type conductivities (σ_n) of GDC with the in-plane geometry are about 50% higher than those of GDC with the bulk geometry (two-probe technique), and those values are in good agreement with the values of GDC with the four-probe technique. Even though the contribution of the overpotential to the total resistance is about 50 % in this study, in other cases this contribution can be much higher. This approach can reduce the contribution of the overpotential by more than two orders of magnitude by using the thick-film geometry in any case, and rule out the overpotential problem in the two-probe technique.