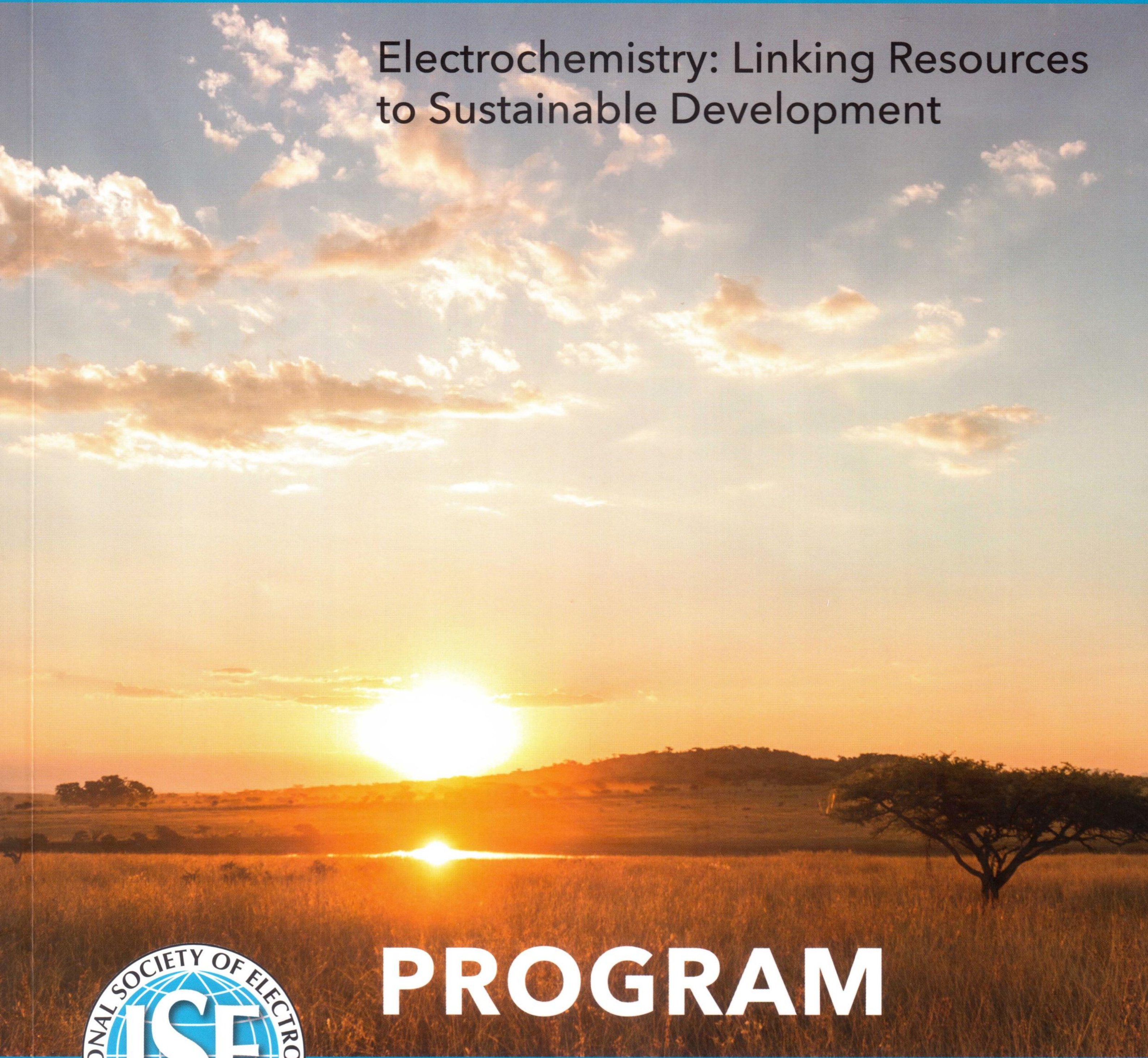
70th Annual Meeting

of the International Society of Electrochemistry

4 - 9 August 2019
Durban, South Africa



Electrochemistry: Linking Resources to Sustainable Development

PROGRAM

http://annual70.ise-online.org
e-mail: events@ise-online.org

Symposium 3b Fuel Cells, Biofuel Cells and Electrolyzers

Room : 11-CD

Chaired by : Aleksey Yaremchenko

09:30 to 09:50

Aleksey Yaremchenko (*Department of Materials and Ceramic Engineering, CICECO - Aveiro Institute of Materials, University of Aveiro, Aveiro, Portugal*), Blanca Arias-Serrano, Kiryl Zakharchuk, Jorge Frade

Composite LnNiO3+PrOx Oxygen Electrodes for Solid Oxide Cells

09:50 to 10:10

Chusheng Chen (*Department of Materials Science and Engineering, University of Science and Technology of China, Hefei, China*)

Solid oxide electrochemical cells supported on the air electrode with large straight open pores and catalyst-coated surfaces

10:10 to 10:30

Csaba Janaky (*Department of Physical Chemistry and Materials Science, University of Szeged, Szeged, Hungary*), Dorottya Hursan, Angelika Samu

Carbon-dioxide Reduction on N-doped Carbon Electrodes: Structure-activity-stability Relationships.

10:30 to 10:50

Alexander Bagger (*Department of Chemistry, University of Copenhagen, Copenhagen, Denmark*), Jan Rossmeisl

The electrochemical CO_2 reduction reaction: Understanding the selectivity of the Cu catalyst.

10:50 to 11:10 Coffee Break

THURSDAY AM

Symposium 4 Renewable Energy and Photo-Electrochemistry

Room : 22-ABC

Chaired by : Ladislav Kavan

09:30 to 09:50

David Fermin (*School of Chemistry, University of Bristol, Bristol, United Kingdom*), Devendra Tiwari

Bismuth-based Solar Absorbers for Solar Energy Conversion

09:50 to 10:10

Siyabonga Beizel Mdluli (*Chemistry, University of the Western Cape, Cape Town, South Africa*), Morongwa Emmanuel Ramoroka, Suru Vivian John, Emmanuel Iwuoha

Novel Core-Shell Electroresponsive 3-Dimensional Poly(*propylenethiophenoimine*)-co-Poly(*3,4-ethylenedioxythiophene*) Dendritic Star Copolymers: Synthesis and Photophysical Properties

10:10 to 10:30

Hayelom Hiluf Tesfay (*Chemistry, University of the Western cape, Cape Town, South Africa*), Emmanuel Iwuoha

Characteristics of $Cu_2Zn_{1-x}FeSnS_4$ Nano-crystalline Kesterite Material towards thin Film PV Cell Application.

10:30 to 10:50

Kang Shi (*Department of Chemistry, Xiamen University, Xiamen, China*), Huiqin Hu, Liangliang Zhang, Yanzheng Xu

Photoelectrochemical Etching for Preparing Ultrasmooth Gallium Nitride Surface in Acidic Electrolyte

10:50 to 11:10

Coffee Break

Composite $LnNiO_3$+PrO_x oxygen electrodes for solid oxide cells

Aleksey Yaremchenko, Blanca I. Arias-Serrano, Kiryl Zakharchuk, Jorge Frade
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$Ln_2NiO_{4+\delta}$ and its derivatives with perovskite-related K_2NiF_4-type structure demonstrate high mixed ionic-electronic conductivity, moderate thermal and negligible chemical expansion. As a result, these phases attracted significant attention as prospective cathode materials for intermediate-temperature solid oxide fuel cells (IT-SOFC). At the same time, perovskite-like $LnNiO_3$ has not been considered for these applications, mostly due to the limited phase stability under ambient oxygen pressures. On heating in air, $LaNiO_3$ decomposes at ~ 1000°C; cathodic polarization can be expected to induce the decomposition of perovskite phase at lower temperatures characteristic for IT-SOFC operation. On the contrary, redox changes imposed by anodic polarization (in solid oxide electrolysis cell mode) under oxidizing conditions should not be of risk for the phase stability of $LaNiO_3$. The goal of the present work was the evaluation of $LnNiO_3$-based oxygen electrodes for solid oxide fuel/electrolysis cells.

The $LnNiO_{3-\delta}$ ceramic powders with perovskite-like structure was prepared by glycine-nitrate combustion synthesis followed by calcinations in oxygen atmosphere at 800-1000°C. Porous ceramic samples for electrical and dilatometric studies were sintered in oxygen at 950-1050°C.

Porous $LaNiO_{3-\delta}$ samples were found to exhibit favorably high *p*-type metallic-like electrical conductivity, 400-500 S/cm at 800-600°C in air. These ceramics demonstrated also a moderate thermal expansion, with average CTE ~ 13.0 ppm/K at 25-800°C, ensuring thermomechanical compatibility with solid electrolytes.

As a first step, the electrochemical performance of $LaNiO_{3-\delta}$ electrodes was assessed in contact with three common electrolytes including $(ZrO_2)_{0.92}(Y_2O_3)_{0.08}$ (8YSZ), $Ce_{0.9}Gd_{0.1}O_{2-\delta}$ (CGO10) and $(La_{0.8}Sr_{0.2})_{0.98}Ga_{0.8}Mg_{0.2}O_{3-\delta}$ (LSGM). The electrode layers were sintered at 1050°C for 2 h under oxygen flow. The studies of symmetrical cells by EIS demonstrated that the electrochemical activity of $LaNiO_{3-\delta}$ electrodes increases in the sequence 8YSZ < CGO10 < LSGM; the corresponding values of electrode polarization resistance (R_η) at 800°C were 1.4, 0.8 and 0.25 Ohm×cm2, respectively. Significant variations of R_η with electrolyte composition correlate with the extent of chemical reactivity between $LaNiO_{3-\delta}$ and electrolyte materials during the electrode fabrication.

The R_η values of $LaNiO_{3-\delta}$ electrodes in contact with LSGM electrolyte were further reduced to 0.03 Ohm×cm2 at 800°C and 0.11 Ohm×cm2 at 700°C by the surface modification with PrO_x which is known for its electrocatalytic activity. At 750°C and current density of 0.5 A/cm3, $LaNiO_3$+PrO_x (~20 wt.%) electrodes in contact with LSGM solid electrolyte demonstrate the overpotentials of ~60 mV under cathodic polarization and ~40 mV under anodic polarization (Fig.1).

The impact of substitution of lanthanum by praseodymium (in order to improve the chemical compatibility and electrochemical activity) on the relevant properties of $LnNiO_3$ is briefly discussed.

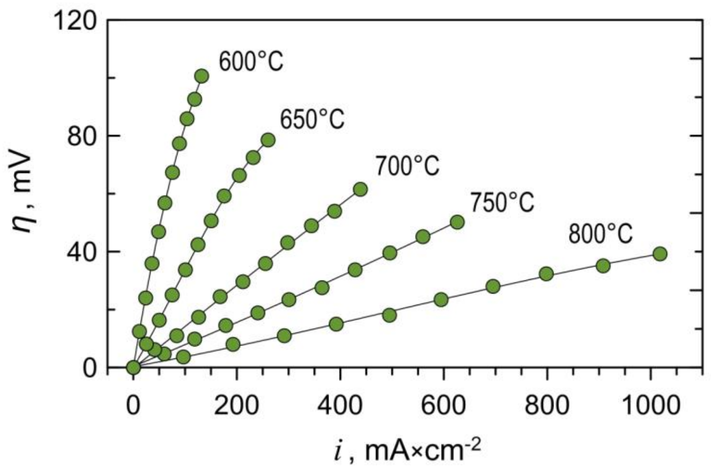

Figure 1. Anodic overpotentials of $LaNiO_3$+PrO_x (~20 wt.%) electrodes in contact with LSGM solid electrolyte in air.