THINNIA: Nano-sized proton conductors for the next generation of environmentally friendly fuel cells

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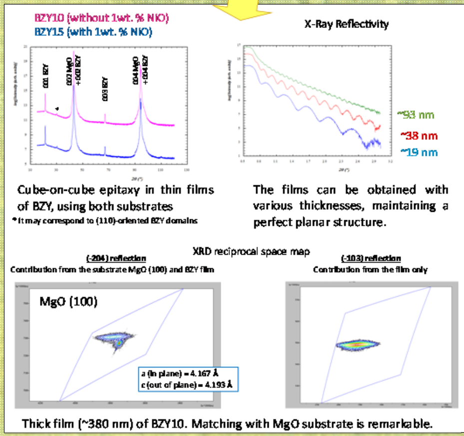
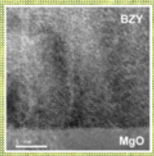
This research proposal is oriented towards the understanding of fundamentals in nano-sized proton conducting oxide systems. For achieving this goal, the first step is to fabricate the nano-systems with control over the growth process at an atomic scale, leading to high quality epitaxial thin films and multilayers of proton-conducting oxides. We are interested in studying the influence of pulsed laser deposition conditions in film microstructure, particularly at the interfacial region, and how strain and the presence of defects may influence the materials charge transport, as well as oxygen surface exchange properties. The application of these novel nanostructured devices in electrochemical devices (e.g. solid oxide fuel cells, gas separation membranes, gas sensors) is considered to be the key for the development of future energy technologies for the generation of more efficient and clean energy.

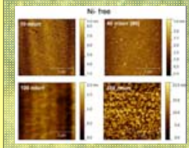
Films obtained by PLD

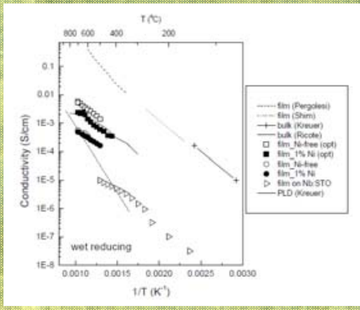


We hereby report developments on the fabrication and characterization of epitaxial thin films of Y-doped $BaZrO_3$ (BZY) by pulsed laser deposition (PLD) on standard single crystal substrates (MgO, GSO, STO, NGO, LAO and sapphire) using Ni-free and 1% Ni-containing targets. Epitaxial thin films of BZY are obtained in all cases (except for sapphire), even in the case of large lattice mismatch from 5.5 to almost 10 % for the perovskite-type substrates. The deposition conditions influence the morphology, cell parameters and chemical composition of the film characteristics, the oxygen partial pressure during film growth being the most determining. The Characterization was carried out using X-ray diffraction (XRD), transmission and atomic force microscopy, electron probe microanalysis and angle-resolved X-ray photoelectron spectroscopy. The proton conductivity of the films depends on deposition conditions and thickness, and for the optimised thin film the conductivity is slightly higher than the bulk conductivity of the Ni-free target (3 mS/cm at 600 °C, in wet 5% H_2/Ar).

Properties of the films







Future cooperations

M-ERA.NET is an EU funded network which has been established to support and increase the coordination of European research programmes and related funding in materials science and engineering.

M-era.Net

Transnational call
4 european partners:

Universitas Osloensis · ICN2 Institut Català de Nanociència i Nanotecnologia · SINTEF · Universiteit Twente

SURKINOX project (granted February 2016)

Despite excellent progress in development and manufacturing technologies of ion and mixed ion-electron conductors, fuel cells, electrolysers and gas separation membranes do not exhibit the anticipated performance. There is a need for expanding knowledge *on surface exchange mechanisms, their corresponding kinetics and the relation between surface and bulk characteristics* in nano-engineered materials and assemblies. The SURKINOX project will develop novel approaches to design property-driven materials with nano-functionalized surfaces and nano-structured thin films as well as necessary experimental techniques to reveal surface exchange parameters. This will have a significant technological impact by increasing system efficiency. The project benefits to academia for the generic knowledge applicable to various processes embedding catalytic reactions and to value-chain industries: powder and ceramics suppliers, technology developers and end-users (power plants, CO_2 intensive industries).

NEW EU H2020 PROJECT STARTING IN SUMMER 2016

CONCLUSIONS

There is a growing interest to find alternative technology that can produce green and environmentally friendly energy at a global scale. More research efforts and higher investments need to be done in order to succeed.

NILS mobility project

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Iceland Liechtenstein Norway eea grants