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Title: Key Issues in the Manufacturing of Solid Oxide Fuel Cells with Nanometric Powders

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Abstract

The climate change, the decreasing of petroleum supplies and the abrupt increase of the energy demand due to the emerging countries and to an energy-hungry society, has driven the interest towards new energy and more efficient devices of energy production. Only a strong acceleration of alternative devices of energy production and an increase of renewables, can succeed in reducing pollution, improving the climate and at the same time assuring the energetic autonomy and competitiveness. In this scenario, electrochemical cells show several economic and environmental advantages compared to the conventional industrial processes. Fuel cells are an excellent alternative to the conventional systems of energy production in terms of CO_2 emissions, low noise and flexibility of fuels and generated power. Solid oxide fuel cells (SOFC) in particular, are one of the most promising energy devices for their high efficiency, modularity, low emissions and the possibility to be directly fuelled with natural gas, GPL and alcohols. Lot of efforts are however necessary to develop commercially available generators and to increase their stability lowering at the same time their costs. These hurdles can be partially overcome lowering the operating temperature but also using more economic and easily scalable manufacturing techniques. These objectives can be reach deepened the knowledge on the relationships between SOFC materials and the main industrial production processes (tape casting and screen printing) necessary to obtain cell of dimensions close to the commercial ones with easily scalable processes.
In this work the main issues related to tape casting and screen printing of nanopowders for SOFC ceramic devices is presented. Nano-powders represent the forefront of materials for SOFC. Nano-structured powders exhibit in fact important size-dependant properties such as high catalytic activity, low sintering temperatures and therefore high performances. Aim of this study is to find the correlation that link the process parameters with the nano-materials properties in order to enhance the performances and the durability both of the materials and of the final device. One of the most critical issue is to produce homogeneous and stable ceramic suspensions of nanopowders. The process optimization can be obtained merging the surface and morphological properties of the nanopowders considered (shape, dimensions' distribution, surface area, etc.) to its behavior in suspension (viscosity, zeta potential, etc.) either organic of water-based, in order to obtain a well dispersed and homogenous system. With this kind of control, it is possible to produce large area reliable devices with the necessary reproducibility and reliability.

Biography

Alessandra Sanson gained her MSc in Industrial Chemistry (110/110) at the University of Padua in 2000 and her PhD at Cranfield University (UK) in 2003. She was employed by Euspen (european society for precision engineering and nanotechnology, UK) as European Scientific Development Coordinator in 2003. In 2004 she joined as researcher the advanced ceramic processing group at the Institute of Science and Technology for Ceramics (ISTEC-Faenza) where she is now part of the permanent staff. Since January 2008 she is in charge of

the research programs related to the ceramic processes connected with materials for energy applications of ISTEC. She is involved in several national and international projects and she cooperates in projects with private companies like CRF, Pirelli Labs, FIAMM Spa and Thales Alenia Space on the production of multilayers structures obtained by tape casting and/or screen printing. She is supervisor of MSc as well as PhD students of Padua and Bologna University and lecturer of "Advanced Ceramics Processing Techniques" and "Ceramics for Energy Applications" of the Chemistry Doctoral School of Bologna University. Since October 2008 she is lecturer of "Industrial Processing for Ceramics" at Istituto Superiore per le Industrie Artistiche (ISIA) of Faenza. Her main activities concern the synthesis and characterization of advanced ceramics nanopowders and their shaping processes. Among the latter, other than the most common used for bulk materials (pressing, slip-casting and extrusion) the research is nowadays focused on near net shape techniques as freeze-drying and gel casting. Her experience is completed by a solid background in thick film deposition (screen printing, tape casting, etc.) and on the main techniques for obtaining stable suspensions of micro and nano-powders to be used in the abovementioned processes.