ABSTRACT QUESTIONNAIRE

Please, fill out all fields of this questionnaire and together with your abstract send it by e-mail to the Symposium secretariat (hyceltec2013secretariat@leading.pt) in a PDF format file.

Title:	Fabrication of Ni-YSZ tubes by powder extrusion moulding for SOFC electrolytes				
Presenting author:	B. Levenfeld	**Under 30 years old**		**Presentation in English**	x

EXPECTED CLASSIFICATION: (please, mark all the options that better define your abstract)

	MAIN SESSION
	PEM fuel cells
x	SO fuel cells
	Other fuel cells
	Batteries
	Supercapacitors
x	Hydrogen
	Other

	SUB-CLASSIFICATION
	Numerical simulation
	New materials
X	New processes
	Prototype development
	Engineering & integration
	Industrial project
	Marketing analysis
	Standards and regulations

Fabrication of Ni-YSZ tubes by powder extrusion moulding for SOFC anodes

B.I. Arias[1], A. Várez[1], B. Levenfeld[1*], H. Monzón[2], M. A. Laguna-Bercero[2] and A. Larrea[2],

[1]*Dpto. Ciencia e Ingeniería de Materiales. Universidad Carlos III de Madrid. Avda. Universidad 30 28911 Leganés, Spain*
[2] *Instituto de Ciencia de Materiales de Aragón (ICMA), CSIC- Universidad de Zaragoza, C/ María de Luna 3, E-50018 Zaragoza, Spain*

(*) bll@ing.uc3m.es

Abstract

Thin wall thickness tubes, for anode supported solid oxide fuel cells (SOFC), were successfully fabricated by means of thermoplastic Powder Extrusion Molding (PEM) using a mixture of powder (NiO, YSZ and cornstarch as a pore former powder). This technology has been successfully developed for manufacturing of NiO-YSZ microtubes with 400 μm of thickness. The thermoplastic extrusion process involves several steps, as shown in Figure 1. The steps are similar to those of powder injection molding. One of the most critical step is the formulation of the feedstock (mixture of powder and binder).The binder used was the same used for the manufacturing of YSZ tubes, which was a multicomponent thermoplastic system based on polypropylene (PP), paraffin wax (PW) and stearic acid (SA) with a volume ratio of 50/46/4. The formulation of the powder loading was fixed to 34/41.5/24.5 of NiO, YSZ and cornstarch respectively. The effect of particle size of NiO powders was also evaluated and we have prepared feedstock using NiO powders with two average particle size (1 and 10 μm). In order to optimize the feedstock formulation, different feedstocks with different powder solid loading were prepared and characterized. The powder amounts varied from 45 to 65 vol%. Firstly powder-polymer mixtures were prepared in a rotor blade mixer with torque control.This measurement allowed to estimate the homogeneity of the samples and the maximum powder loading. Feedstock prepared with the biggest particle size NiO powders showed the highest torque values and the homogeneity was considerably lower than those prepared with the smaller particle size. The maximum powder loading for the two feedstock series (10 and 1 μm) was 55% and 65%. In order to determine the suitability of the different feedstock for extrusion process a rheological study was performed in a capillary rheometer. The dependence of viscosity on shear rate of all prepared feedstock (Fig.2) was described by the so-called powder law. All of them showed a pseudoplastic behavior, which is the most adequate for the extrusion process. Although the mixture with 65% of powder had a suitable viscosity was discarded due to dilatant behavior induced by the presence of cornstarch. Consequently feedstocks with 60 vol. % of powder loading exhibited the most suitable behavior for thermoplastic extrusion moulding. Binder removal was carried out by a combination of thermal and solvent debinding and tube were obtained without swelling and cracks. Deposition of electrolyte and cathode were also performed and will be presented in this Congress. Preliminar j-V test on SOFC cells using this tubes showed similar results to state of the art YSZ based microtubular SOFC.

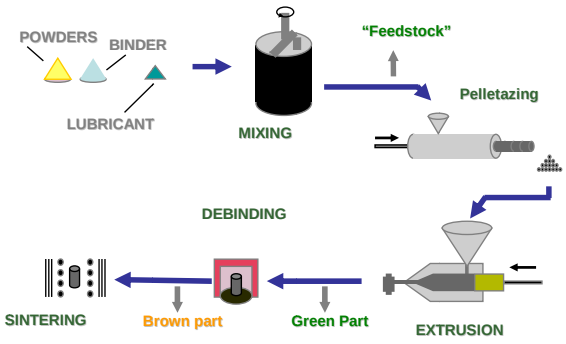

Fig.1.- Scheme of the Powder Extrusion Moulding (PEM) process

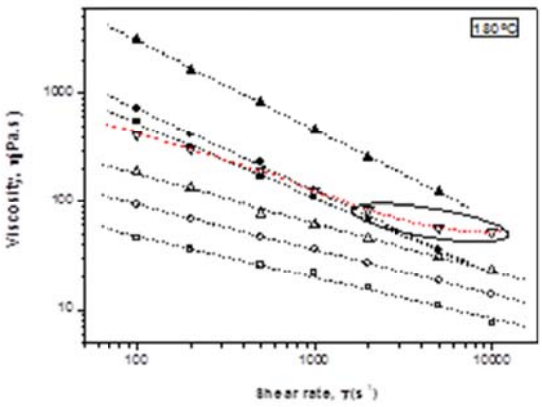

Fig. 2.- Viscosity curves of feedstocks with different powder loading and different NiO particle size.

Keywords: *SOFC, Powder Extrusion Moulding, Microtubular*