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Extrusion of thin tubular membranes of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (BSCF)

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Abstract – Ceramic membranes made from mixed ionic-electronic conductor (MIEC) can selectively separate oxygen from air. These membranes are promising for use in many industrial processes that require a continuous supply of pure oxygen. In this work, the main aim was the development of thin tubular $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ perovskite membranes by extrusion process with a wall thickness of ~300 µm. The influence of the additive used to extrude the tubes was analyzed, considering polymeric binders, e.g. polystyrene, polyethylene and polyethylene glycol. It was investigated the degree of roundness, straightness and the deformation before and after debinding step for different binder systems.

How to obtain cheap, pure oxygen is a very important issue in the industry. Dense ceramic membranes made from mixed ionic-electronic conductor (MIEC) perovskite oxides can selectively separate oxygen from air or other gases without using any external voltage. These membranes have become of great interest as a potentially economical, clean and efficient means of producing oxygen by separation from air or other oxygen containing gas mixtures [1,2].

In this work, the main aim was the development of thin tubular $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ perovskite membranes with a wall thickness of less than 300 µm. It was analyzed the influence of the quality of thermoplastic extruded tubes with different polymeric binder and a mixture of them, e.g. polystyrene (PS), polyethylene (PE) and polyethylene glycol (PEG). Degradation of the polymer during forming, as well as the roundness, straightness and the deformation before and after debinding step were investigated for the different binder systems. Fig. 1 shows a general view of the process.

The homogenized powder-polymer feedstocks were extruded using a capillary rheometer, RH7 Flowmaster; Bohlin Instruments. Tubes were obtained with out diameter of approximately 10 mm and with wall thickness of 300 µm. The extrusion temperatures varied between 140°C and 190ºC, as a function of the binder used in the feedstock composition.

The green tubes were placed in the muffle furnace for the thermal debinding process. Binder removal schedules consisted of a series of heating steps and multiple dwell times.

The visual inspection of the tubes before and after debinding was done to see how good the straightness was and some external defects, by optical microscope. For all feedstock compositions were measured the out diameter (top, middle and bottom) and wall thickness of the tubes before and after debinding. The Measurements were done by optical microscope equipped with a setup to measure distances; Laser Equipment (Optical Micrometer). Fig. 2 shows tubes aspects.

The tubes after debinding were sintered with no atmosphere control in the oven fired at 800ºC. To obtain shrinkage of the out diameter and wall thickness the measurements were done before and after debinding.

Taking into consideration the tubes characterization before and after debinding, the mixture PS80%+PEG20% feedstock presented the best results.

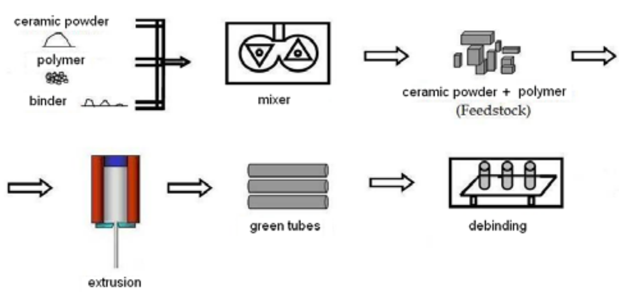

Figure 1: General view of tubes processing.

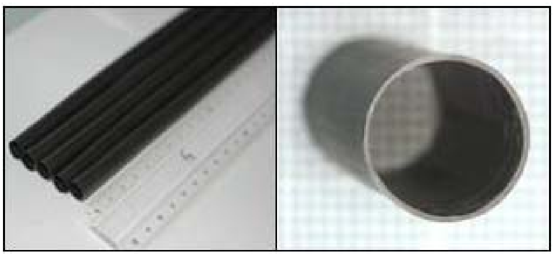

Figure 2: Tubes showing perfect roundness and straightness.

References

[1] H. Wanga, R. Wangb, D. T. Liangb, W. Yanga, Experimental and modeling studies on Ba0.5Sr0.5Co0.8Fe0.2O3−δ (BSCF) tubular membranes for air separation. Journal of Membrane Science 243 (2004) 405–415

[2] P. Pandey and R. S. Chauhan, ‘‘Membranes for Gas Separation,’’ Prog. Polym. Sci., 26, 853–93 (2001).