Synthesis and characterization of TiO_2 ceramic substrates obtained by processes of the compaction and slip casting

E. E. M. Oliveira[1], C. de S. Pereira[1], G. P. S. Gonzales[2]
E-mail: eemo@ien.gov.br, cristina@ien.gov.br, giovanagonzales1@gmail.com

[1] *Serviço de Tecnologia de Materiais e Química, Instituto de Engenharia Nuclear - CNEN/RJ.*
[2] *Instituto de Química, CT - UFRJ.*

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The aim of this work is to obtain ceramic substrates based on titanium oxide (TiO_2) by powder compaction and slip casting. The ideal support must show interconnected porosity in the range of 30 to 35%. The function of ceramic supports is to provide mechanical resistance when covered by a thin layer of a colloidal solution (sol-gel) of TiO_2, forming a ceramic membrane. Membranes are defined as a barrier that separates the two phases and that restricts, totally or partially, the transport of one or several species present in the phase [1]. Ceramic membranes are refractory and have high chemical stability, resistance to high temperatures and radiation [2]. The techniques used in this work for obtaining ceramics substrates were by slip casting in plaster molds and by the process of compacting dry powders in spray-dryer, pressure of 1.5 $kgfcm^{-2}$. The ceramic substrates were sintered at temperatures of 1100 and 1150ºC/1h. The Table 1 shows the geometric and hydrostatic porosity of the substrates milling for 15 and 60 min and sintered at the temperatures of 1150ºC and 1100ºC, respectively. The Table 2 shows the hydraulic permeability of both substrates sintered to 1150ºC. Permeability is the measure of the greater or lesser ease that the support offers a passage of a given solvent, in this case, water.

Table 1 - Values of the geometric and hydrostatic porosity of the substrates TiO_2

Substrates	Milling time (min)	Geometric porosity (%)	Hydrostatic porosity (%)
Slip casting	15	24.5±0.1	24.0±1.0
	60	35.1±4.8	33.7±0.2
Compaction	-	32.8±1.0	33.2±0.8

Table 2 – Hydraulic permeability of substrates

Substrates	Hydraulic permeability ($Lh^{-1}m^{-2}bar^{-1}$
Slip casting	6.90
Compaction	13.18

The supports obtained by slip casting ground for 15 min and sintered at 1150ºC, presented porosity below the ideal (30-35%), while the slip casting ground for 60 min and sintered at 1100ºC showed porosities between 33-35%, ideal for application as a ceramic substrate, probably the longer milling time resulted in smaller particles and thus more reactive.

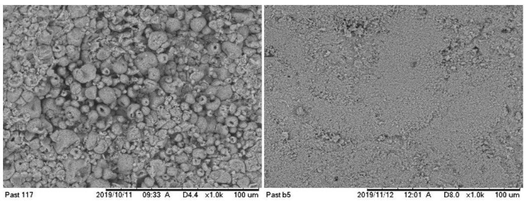

Figure 1. Micrographs show substrates obtained for compaction (117) and slip casting (b5), sintered at 1150°C.

As can be seen in Figure 1, the support obtained for compaction (117) has a surface with large agglomerates, probably due to an incomplete sintering process, proven through hydraulic permeability was higher compared to slip casting (b5), as shown in the Table 2. The results showed that the slip casting process was effective and obtained better substrates to be covered with colloidal TiO_2 suspension to obtain a ceramic membrane, as proposed by our project.

References

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