Ordered Assembly of Oxide Nanotubes in Porous Alumina Membranes for Biomedical Applications

C.T. Sousa[1]*, *M.P. Proença*[1], *D.C. Leitão*[1], *J.P. Araújo*[1], *A.M.L. Lopes*[2] *J. G. Correia*[3], *C. Nunes*[4], *M. Lúcio*[4], *S. Reis*[4], *J.L.F.C. Lima*[4]

[1]*IN-IFIMUP and Dep. Física, Rua do Campo Alegre 687, 4169-007 Porto, Portugal*
[2]*CNFUL, Av. Prof. Gama Pinto, 2, 1649-003Lisboa, Portugal*
[3]*ITN, Estrada Nac. N10, Apartado 21 – 2686-953 Sacavém, Portugal*
Tel. +351 220402356 Fax. +351 22402406
[4]*REQUIMTE, Servico de Química-Física, Faculdade de Farmácia,*
Universidade do Porto, Rua Aníbal Cunha, 164, 4099-030 Porto, Portugal
celiasousa@fc.up.pt

The great advances in nanoscience and nanotechnology in the last decade have lead to the development of new platforms where all physical properties like size, porosity, geometry and surface functionalization can be controlled at the nanoscale. The research devoted to this field is pushed by the potential applications offered by such structures in several areas, ranging from spintronics to nanomedicine. Particularly, high aspect ratio inorganic nanoparticles have arouse great interest and shown many potentialities [1]. While in the former area, these nanomaterials appear as key components for applications in nanoscale electronics, optics and sensors, in the latter they can be used for biomedical applications such as drug delivery and bioseparations, profiting from the fact that inner voids can be filled with species, ranging in size from large proteins to small molecules.

In this work we used nanoporous alumina membranes to produce two types of oxide nanotubes: silica (SiO_2) [2] and perovskite manganites ($R_{1-x}M_xMnO_3$) [3], via the sol-gel template method. These templates can be easily fabricated using adequate anodization conditions and the pore size and interpore distance easily varied. Furthermore, their use for growth of nanotubes has enormous advantages: the possibility to build a net of aligned and ordered nanostructures, the chance to fill or functionalize their inner side without affecting their outer surface and the ability to control the dimensions required. Using this method, not only we can control the length of the nanotubes, but we can also control their diameter and thickness, allowing us to vary these characteristics along their surface.

We will present an optimization of the sol-gel template method using nanoporous alumina membranes. This method allowed us to obtain high quality oxide nanotubes and nanowires of SiO_2 and $La_{2/3}Ca_{1/3}MnO_3$, varying sol-gel parameters such as temperature, concentration and deposition time. The developed methods can be adequately applied to other oxides. We also present the morphological, structural and magnetic characterization of these nanoparticles. In addition, manganite nanotubes inside silica nanotubes, which can be functionalized outside with a target, will also be presented.

References:

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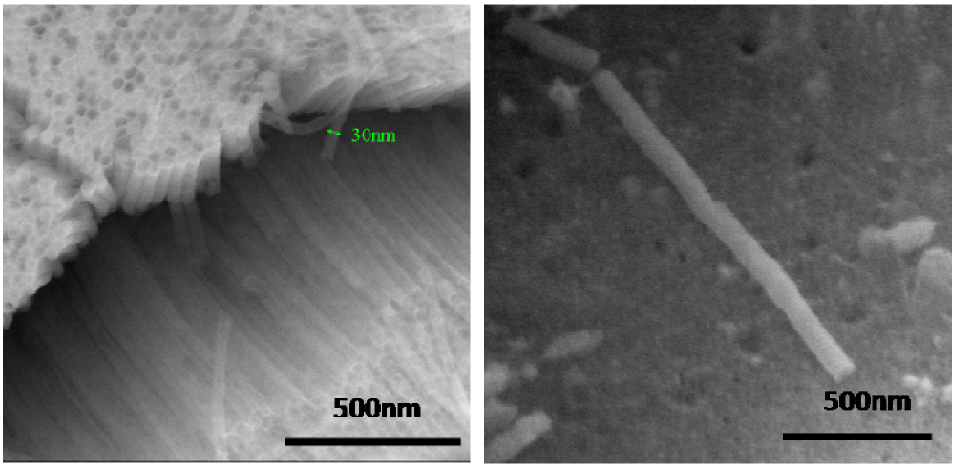
Figures:



SEM images of silica nanotubes and an isolated manganite nanotube obtained by the sol-gel template method.