Investigation of proton exchange on TiO_2-based nanotubes and nanoribbons

F. L. R. Silva, R. F. Martins, F. D. Brandão, K. Krambrock, A. Righi

Universidade Federal de Minas Gerais, Departamento de Física, MG, Brazil
e-mail: righi@fisica.ufmg.br

Nanostructures based on titanium dioxide have been extensively studied due to their potential technological applications, especially in the field of photocatalysis. Since the discovery of a simple wet chemical route, the NaOH treatment of crystalline TiO_2 powders to produce TiO_2-based nanotubes with large surface area, significant interest has been given to this nanostructure [1]. In this study, anatase titanium dioxide nanoparticles were submitted to a hydrothermal treatment statically and under stirring during one and four days. The samples synthesized statically yielded multi-walled nanotubes (Figure 1a), while the samples produced under stirring yielded nanotubes with more walls. On the other hand, the titanium dioxide synthesized during four days under stirring resulted in nanoribbons (Figure 1b). Two samples, one made of nanotubes and other made of nanoribbons, were washed with hydrochloric acid for proton exchange. Scanning and transmission electron microscopy confirmed the formation of these nanostructures, which were also analyzed with X-ray diffraction and Raman spectroscopy. From X-ray diffraction the structures of the nanotubes and nanoribbons were assigned to a $NaTi_3O_6(OH)\cdot 2(H_2O)$. The proton exchange Na to H influences in the position and ratio of the relative intensities of some Raman modes. The shifts in frequency of the bands and the changes in their ratio intensity can be explained by the decrease in interlayer distance and the proton exchange, confirmed by X-ray patterns.

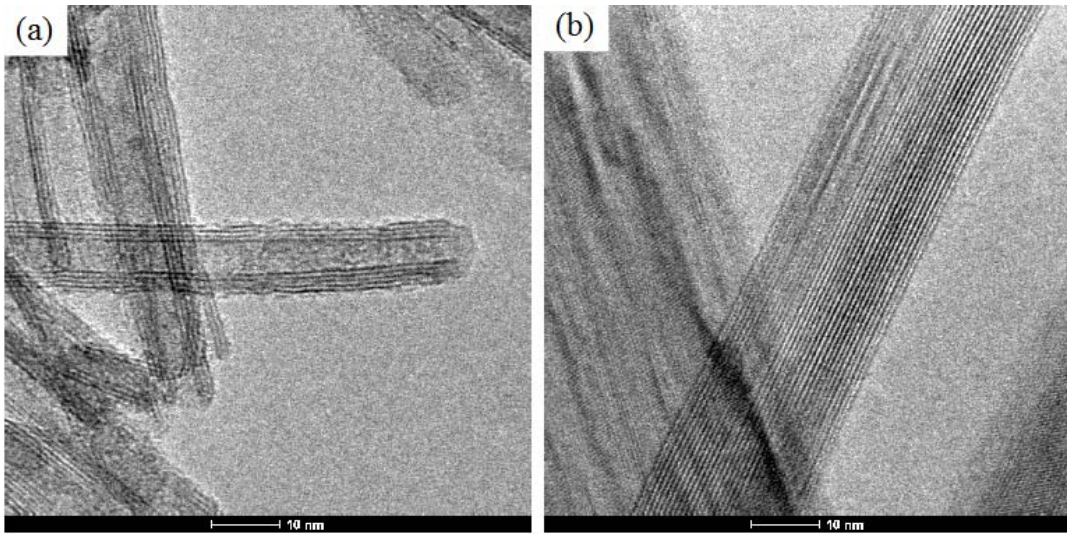

Figure 1: TEM micrographs of titanate nanotubes (a) and nanoribons (b).

Acknowledgments: This work was supported by CNPq, CAPES and FAPESP.

References:
[1] T. Kasuga, M. Hiramatsu, A. Hoson, T. Sekino e K. Niihara, *Langmuir*, **14**, 3160, 1998.