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Morphological and structural analysis of Nb-doped TiO_2 synthesized via Pechini method

G. H. da Silva[1]; E. A. de Almeida[2]; G. T. Tractz[1]
1. Universidade Tecnológica Federal do Paraná; 2. Universidade Estadual de Maringá.
silva.2006@alunos.utfp.edu.br

Introduction

The doping of semiconductor oxides through the incorporation of foreign elements into their crystal structures enables the modification of their physical and chemical properties, that can improve the use of the same oxides in different applications. This study aims to synthesize and characterize niobium-doped titanium oxides at different dopant conditions in order to investigate the influence of niobium incorporation on the structural composition and morphological characteristics of the synthesized samples.

Experimental

The Pechini method was employed for oxide synthesis and doping, using niobium pentoxide supplied by CBMM as the metallic precursor, at concentrations of 0.5, 3.0, and 10.0% (mol/mol), with constant heating and stirring of the reagents, followed by calcination at 600°C for 6 hours. The samples were characterized by XRD, SEM, Zeta Potential and DLS. Also, the synthetisizeds oxides were deposited onto a FTO conductive glass and impregnated with N719 dye for 12 hours for subsequent mounting of the photovoltaic cells, using the Doctor Blading methodology.

Results

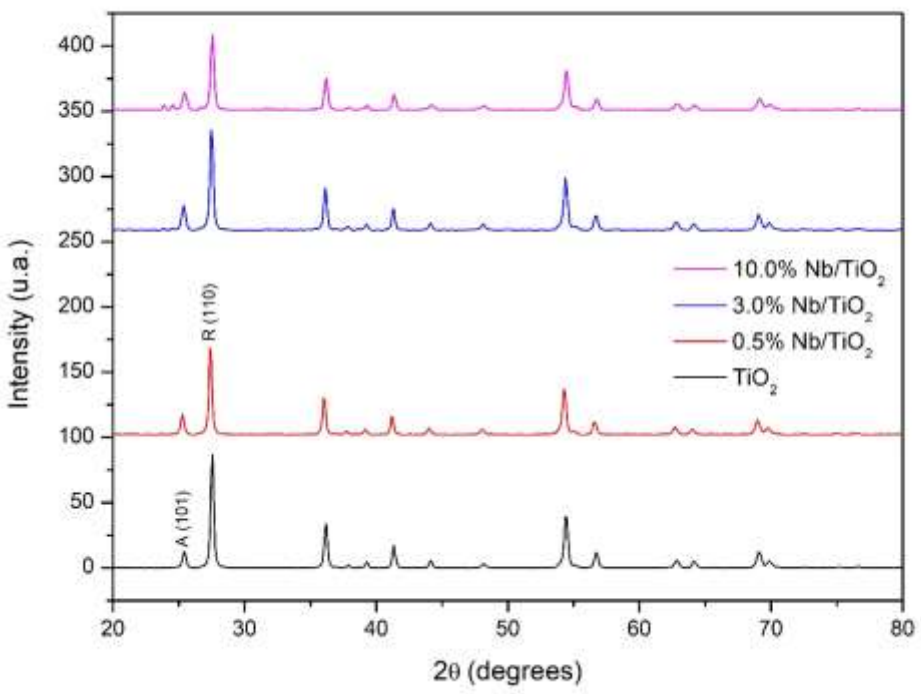


Figure 1 – XRD from the Nb-doped TiO_2 at concentrations of 0.5%, 3.0% and 10.0%.

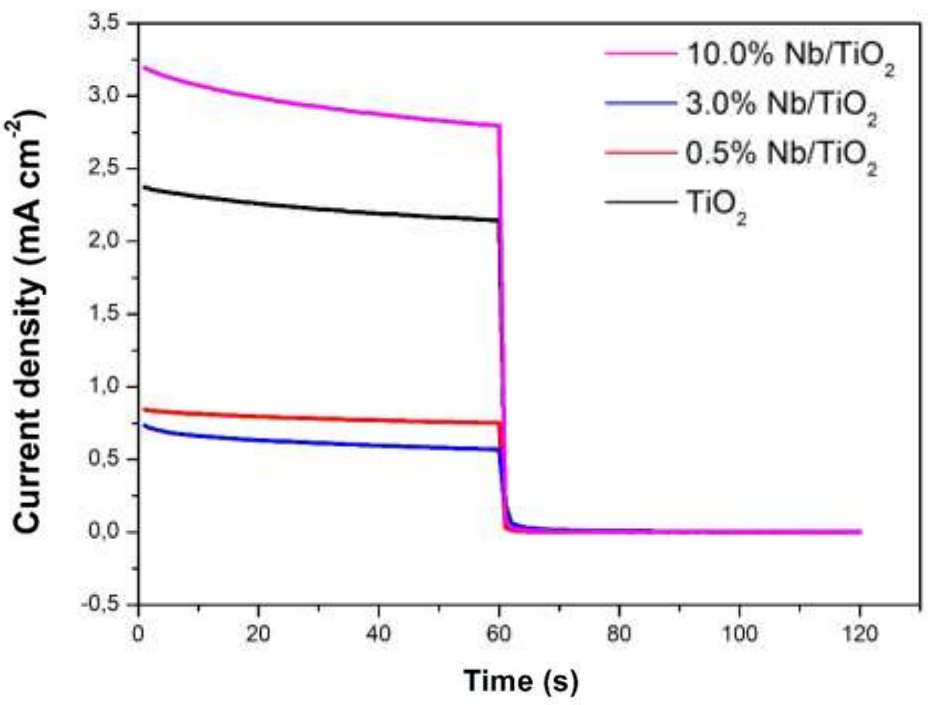


Figure 2 – Photochronoamperometry from the cells built with the Nb-doped TiO_2 samples.

Table 1 – Calculated Band Gap, Hydrodynamic, Diameter and Zeta Potential of the synthesized oxides.

Samples (doping condition)	Calculated Band Gap (Kubelka Munk)	Hydrodynamic Diameter (nm)	Zeta Potential (mV)
Nb – 0.5%	2,90	928,1	-29,8
Nb – 3.0%	2,90	963,6	-11,2
Nb – 10.0%	2,91	980,8	-10,0

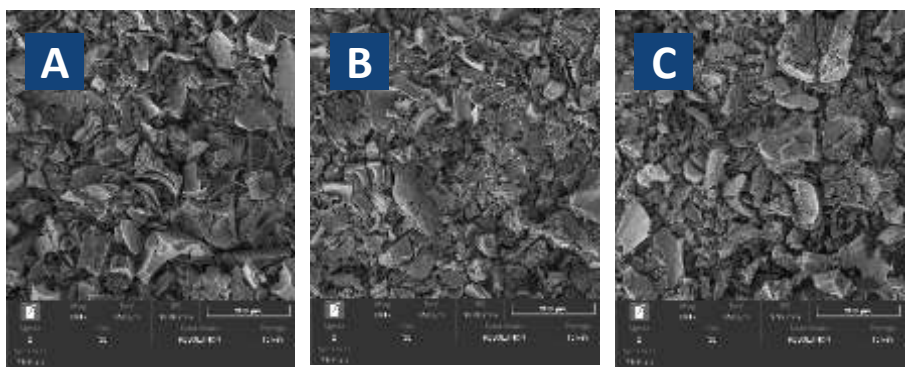


Fig. 3 – SEM from the Nb-doped TiO_2 under the following doping conditions: 0.5% (A), 3.0% (B) and 10.0% (C).

Conclusion

Therefore, the incorporation of niobium was shown to modify the structural and morphological properties of TiO_2, highlighting the potential of these materials for applications in photosensitive devices, electrodes for pollutant detection, photocatalytic thin films, and other advanced technological systems.

References

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unesc A nossa universidade
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UDESC Universidade do Estado de Santa Catarina