Effects of substrate and deposition temperature on epitaxial growth of TiO_2 thin films

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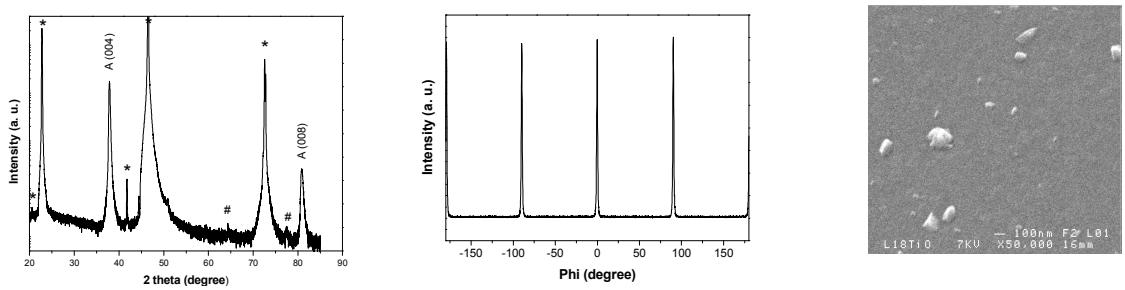
Titanium dioxide, due to its special properties such as large energy gap, high refractive index and dielectric constant, is commonly used in catalysts, optical devices, self-cleaning protective coatings and sensors [1]. A better understanding of catalytic and photocatalytic processes is one of the main driving forces for TiO_2 surface investigation [2]. Different methods of deposition allowed obtaining epitaxial TiO_2 films on various substrates. However, due to the scattering of the reported experimental conditions, it appears quite difficult to extract the specific contribution of the substrates nature and orientation.

In this work we have investigated the influence of substrate and deposition temperature on the growth of TiO_2 films prepared by Pulsed Laser Deposition. The objective is to achieve the most accurate control of the allotropic variety and orientation of TiO_2 thin films that will open the way to a comparative study of the surface effect on their behavior. Films were grown at 600 and 700°C on a wide range of oxide single-crystal substrates ($LaAlO_3$, two orientations of $SrTiO_3$ and MgO, and three orientations of Sapphire). All these films were epitaxially grown as evidenced by accurate X-ray diffraction study and we have shown that we can control various orientations such as (001)-, (102)-, (100)-, (110)- and (112) anatase and (110)-, (001)-, (100)- and (101) rutile. The films surface is homogeneous and crack-free while their morphology is strongly affected by the nature of substrate.

Keywords: Titanium oxide, thin films, pulsed laser deposition, epitaxial growth.



XRD (θ-2θ and φ-scan) and SEM characterizations of TiO_2 thin film deposited on (100) $SrTiO_3$ at 600°C

Work supported by CAPES/COFECUB n° Ph 644/09, CNPq and FACEPE.

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