Nanocrystalline anatase thin films prepared from redispersible sol-gel powders

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Abstract

The technological importance of titania based electroceramic materials has result in several application such as varistor, gas and humidity sensors and photovoltaic devices. The electrical and optical properties of titania thin films strongly depend not only on the crystalline phase but also on the morphology and size of pores and grains. Nanocrystalline anatase transparent thin films were deposited from dip-coating process using an ethanolic suspension of redispersed nanoparticles. TiO2 nanoparticles were prepared by sol-gel route and their redispersability achieved by controlled modification of surface with acetylacetone (acac) and paratoluene sulfonic acid (PTSA) as capping ligand. The effect of the amount of this ligand on the powder redispersability and on the structural feature of nanoparticle films was analysed by small angle X-ray scattering, X-ray reflectometry and X-ray diffraction. As prepared sols and redispersed colloidal suspension present the same average particle size (2.2nm) indicating that the powders are fully redispersible. The experimental results show that the films have a level of porous structure formed by spatially correlated pores. The control of the amount of surface capping ligand allows to the fine tuning of average pores size of dried films. A progressive increase of the apparent density and decrease of average pores size of films was observed by increasing the firing temperature up to 500oC. The presences of surface capping ligands inhibit the crystallite and the pores size grows, hindering the anatase-rutile transformation.