Determination of Amorphous Precursors and Their Effects on the Crystallinity of TiO$_2$ Thin Films Deposited by Pulsed Laser Deposition$^1$

OKAN AGIRSEVEN, JAMES HAGGERTY, JANET TATE, Oregon State University, LAURA SCHELHAS, MICHAEL TONEY, Stanford Synchrotron Light Source, JOHN PERKINS, National Renewable Energy Laboratory, JOHN MANGUM, BRIAN GORMAN, Colorado School of Mines, DANIIL KITCHAEV, WENHAO SUN, GERBRAND CEDER, Lawrence Berkeley National Laboratory, CENTER FOR NEXT GENERATION OF MATERIALS BY DESIGN COLLABORATION — TiO$_2$ is a versatile wide bandgap transparent semiconducting oxide with four well known polymorphs; anatase, rutile, brookite and TiO$_2$ (B). The crystalline polymorphs of TiO$_2$ usually require high temperature processes, such as annealing, to form from an amorphous precursor. These crystal structures are also desired for many industrial applications mainly for their photocatalytic activity, such as degradation of organic wastes. Our research aims to understand the formation behavior of these metastable polymorphs of TiO$_2$ as related to the precursor structure. In this study, TiO$_2$ thin films are deposited at room temperature on fused silica substrates by pulsed laser deposition under different oxygen pressures. Microstructural properties of the films are investigated by XRD, Raman spectroscopy, SEM, XPS, and optical transmission and reflection spectroscopy. We expect the results to shed light on the nature of polymorphic transitions.

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