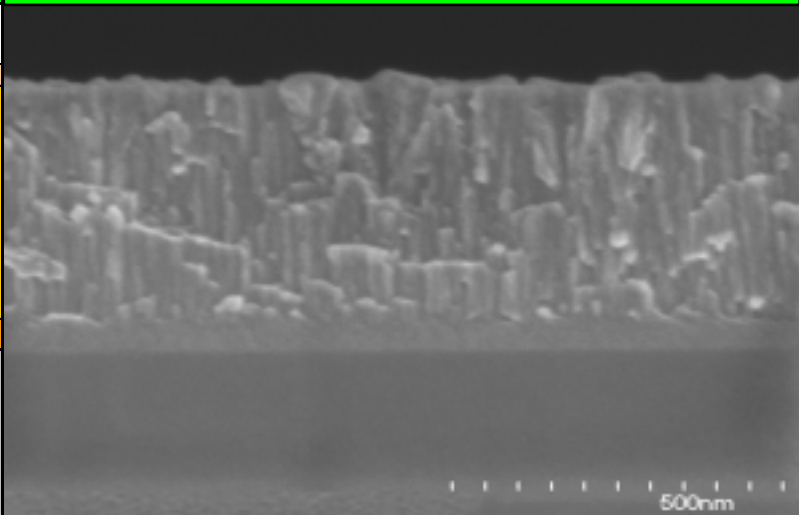


Precise Characterization of Inhomogeneous Dielectric Film by Spectroscopic Ellipsometry (SE)

Precise knowledge of optical properties of dielectric materials is needed for design of photonics devices such as high reflective mirrors used in laser cavities, anti-reflection coatings for improving energy input efficiency, and many different types of filters. Actual optical properties of the films, however, depend on the deposition technique. Therefore, it is necessary to precisely characterize optical constants with the right tool. Ellipsometry known as an absolute, non-contact, non-destructive optical technique, is particularly suitable for thin film characterization. Ellipsometry determines the change in polarization state of the light after its interaction with the sample. A typical ellipsometer comprises a light source, a polarization generator (Polarizer), polarization Analyzer and a light intensity detector. *Spectroscopic ellipsometer (SE)* determines the change in the polarization state of the light over a wide spectral range, and therefore allows to characterize very precisely not only layer thickness, optical constants and in addition, layer homogeneity as shown in the example below.



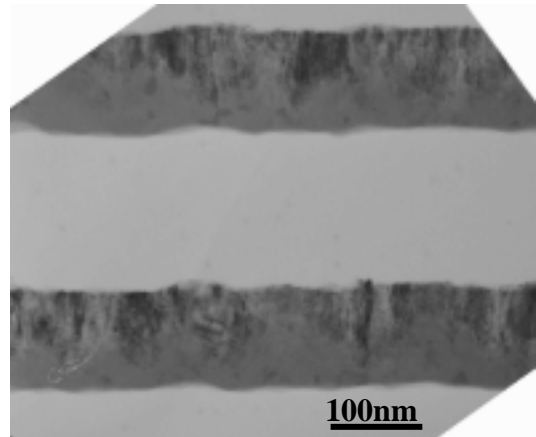
SOPRA GES-5 Angular SE

SE Model		SEM Photo
Thickness (nm)	<u>n@1550nm</u>	
13.5	1.7211	
424.42	2.2363	
66.71	2.2825	
Si Substrate		

This is a TiO₂ dielectric film deposited on silicon wafer with e-beam evaporation technique. A three sub-layers model from SE analysis (1. dense amorphous layer near the substrate, 2. less dense columnar structure and, 3. rough top surface layer) was confirmed by cross-section photo from SEM.

(*)Refer to SOPRA web page (www.SOPRA-SA.com) for tutorial on SE principles, terminology and products.

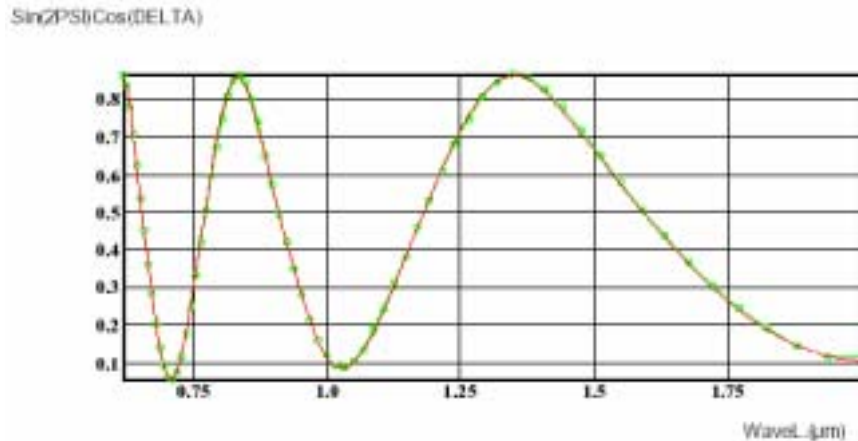
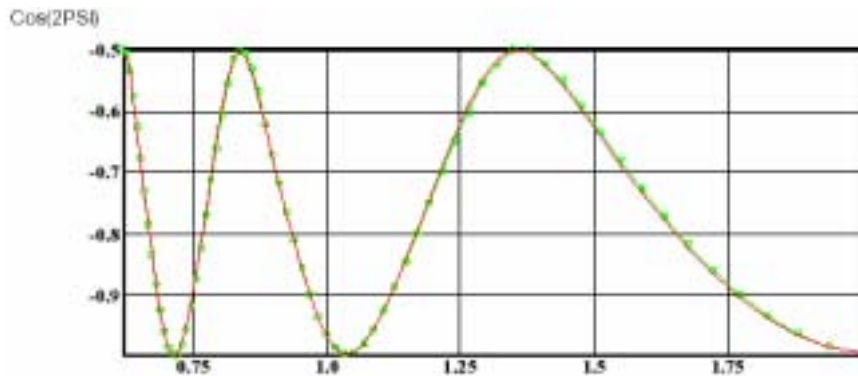
TEM picture (right) shows inhomogeneous structure of TiO₂ film in dielectric stack, which is consistent with the Spectroscopic Ellipsometry Model.



TiO₂

SiO₂

TiO₂



SE measurement data and fitting are shown in above figures for the inhomogeneous TiO₂ dielectric film.

Please contact us for more information.

SOPRA S.A.

26, rue Pierre Joigneaux
92270 Bois Colombes

FRANCE

Tel: (33) 1.47.81.09.49
Fax: (33) 1.42.42.29.34

SOPRA Inc.

323 Littleton Road
P.O. Box 769
Westford, MA 01886
USA

Tel: (1) 978 392-2089
Fax: (1) 978 392-9076

SOPRA GmbH.

Schubertstrasse 9-11
D 64 572 Buttelborn

GERMANY

Tel: (49)-61 52 - 9803-0
Fax: (49)-61 52 - 9803-22

SEIKA Corp.

Koraku International Bldg
5-3, Koraku 1 Chome
Bunkyo-Ku, Tokyo, 112
JAPAN

Tel: (81) 3-5684-7563
Fax: (81) 3-5684-7572

