HORIBA

Scientific

© 2012 HORIBA Jobin Yvon. All rights reserved.

Optical characterization of ITO films prepared in different atmospheres using Spectroscopic Ellipsometry

Celine Eypert , Assia Shagaleeva, Jean-Paul Gaston

HORIBA Scientific, Thin Film Division,
Z.A. de la Vigne aux Loups, 5 avenue Arago
91380 Chilly-Mazarin, France

© 2012 HORIBA Jobin Yvon. All rights reserved.
Company Confidential

Experimental

- Poster : sensitivity of SE on 4 ITO samples at different conditions

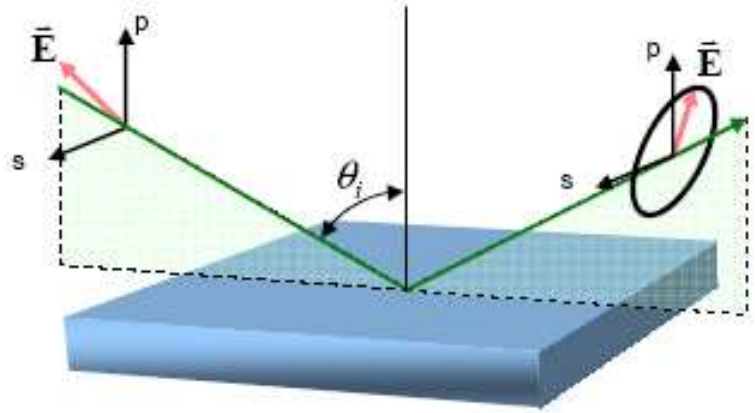
- ITO / c-Si samples
  - DC sputtering (Quorum K675XD)
  - Annealing at 500°C for 4 hours and cooled in various atmospheres,
    - Air
    - N2 (1 bar).
    - Vacuum (0.6 bar)

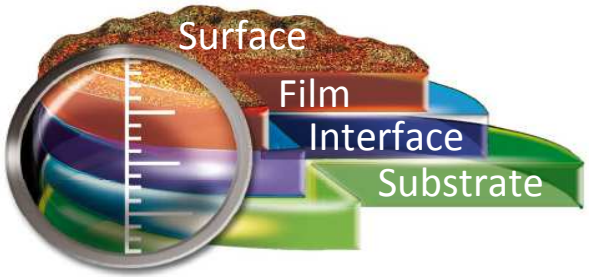
- Spectroscopic Ellipsometry over 190-2100nm
  - ITO Optical Constants
  - ITO Thicknesses

© 2012 HORIBA Jobin Yvon. All rights reserved.

Spectroscopic Ellipsometry Technique

- **Non destructive optical technique to characterise thin films**





$$\rho = \tan(\Psi)e^{i\Delta} = \frac{E_p^{out}/E_p^{in}}{E_s^{out}/E_s^{in}} = \frac{\tilde{r}_p}{\tilde{r}_s} = \frac{|r_p|}{|r_s|}e^{i(\delta_p-\delta_s)}$$

$$\tan(\Psi) = \frac{|r_p|}{|r_s|}$$

$$\Delta = \delta_p - \delta_s$$

Measurement of the changes in the polarization light by reflection from a surface

© 2012 HORIBA Jobin Yvon. All rights reserved.

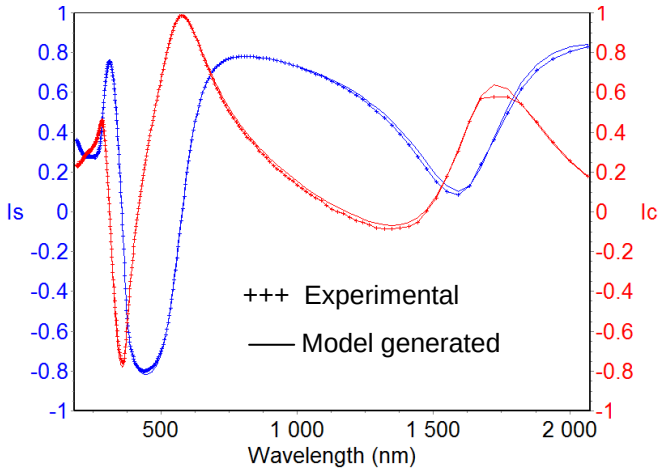
Spectroscopic Ellipsometry Technique

- Non-destructive & contactless technique
- Very sensitive, especially to ultra-thin films: < 10 nm
- No sample preparation
- Liquid or solid samples, transparent and semi-transparent materials
- Spectroscopic measurement: wide spectral range from FUV to NIR
- Multi-layer stacks
- Sample mapping
- Microspot optics for patterned samples
- In-situ real-time measurement: film growth, surface modification

© 2012 HORIBA Jobin Yvon. All rights reserved.

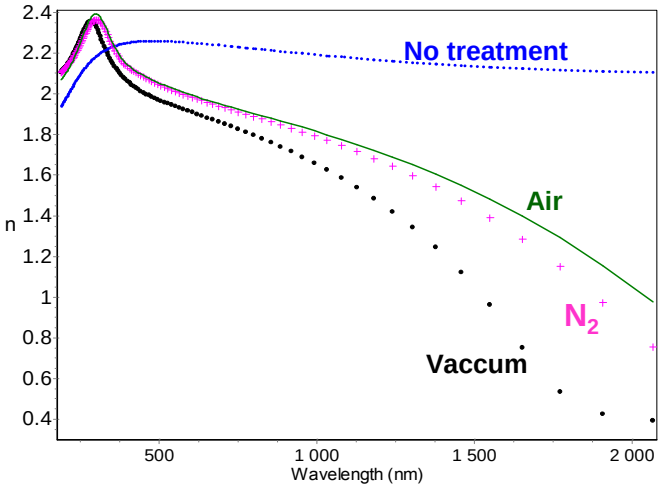
SE Results

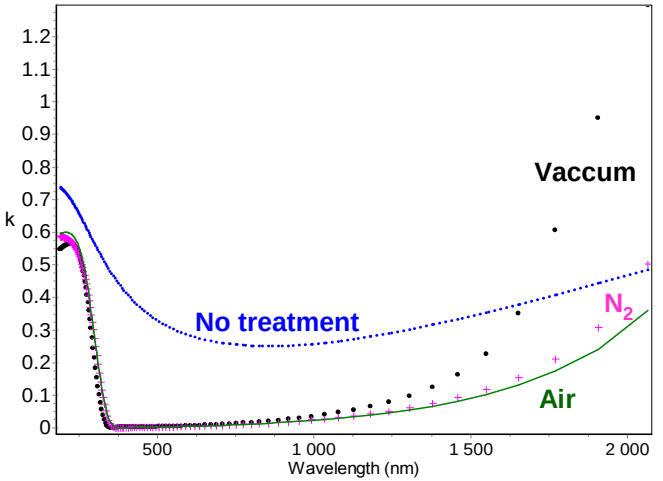
Ellipsometry Fit Agreement



(1-3nm) roughness
(77-85nm) ITO + (n,k)
c-Si

Extracted Optical Properties





© 2012 HORIBA Jobin Yvon. All rights reserved.

Thank you

© 2012 HORIBA Jobin Yvon. All rights reserved.