Application Note

Ref. SE-02

Plasma Display Panel - PDP

Plasma is the state of a matter where atoms are ionized by adding energy. In the context of plasma display technology, a plasma display is a computer video display in which each pixel on the screen is illuminated by a tiny bit of plasma or charged gas, very similar to the way that a fluorescent or neon light works.

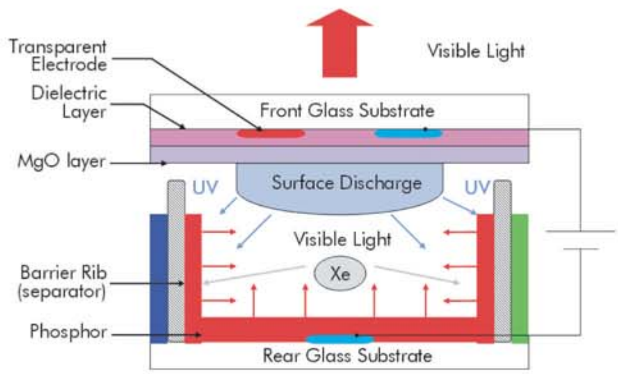
The plasma display technology demonstrates inherent engineering advantages over conventional CRTs (Cathode Ray Tubes) and LCD (Liquid Crystal Display) panels. Plasma displays are thinner than a CRT and brighter than LCD panel. They also offer a very wide viewing angle that is free from distortion at the edges of the screen.

How It Works ?

A plasma display unit is a panel that consists of many tiny cells filled with xenon gas mixed with a buffer gas (typically an inert gas such as neon or helium to optimize ultraviolet emission). When a voltage is applied between two electrodes inside a cell the xenon is excited and emits ultraviolet radiation that in turn excites the phosphors lining the cell, leading to the generation of visible light.

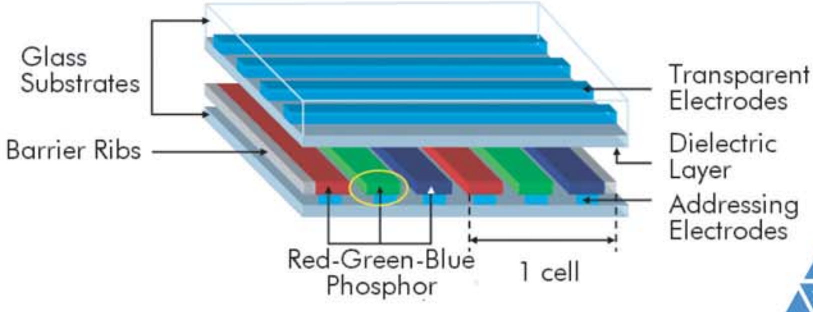
The display screen is an array of cells, known as pixels, which are composed of three subpixels, one for each of the primary colors (red, green and blue). The color output of a pixel is determined by the combination of the subpixels triggered and the intensity to which each subpixel is energized. These subpixels are activated individually, that is to say they emit light individually, creating a precise pixel on the viewing area.

Plasma Cell Cross Section of a Typical PDP



STEP 1 : Creation of a Xe plasma by energizing electrodes
STEP 2 : Xe excitation —> UV radiation
STEP 3 : Phosphor excitation
STEP 4 : Visible light emission

Basic Cell Structure



Mélanie Gaillet - Application Engineer - Thin Film Division

JOBIN YVON HORIBA

PDP Thin Film Structure Characterization

Non destructive characterization of the different PDP films was successfully carried out by Spectroscopic Ellipsometry (SE). The ellipsometric data were collected at an angle of incidence of 70° using the Jobin Yvon UVISEL NIR (260-1700 nm). The SE spectra present (Is, Ic) variables functions of the (Ψ, Δ) ellipsometric angle measurements defined from the fundamental equation of ellipsometry :

$r_p/r_s = \tan\Psi \, e^{i\Delta}$

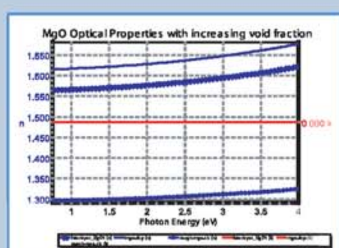
Is and Ic equations are given by :

$Is = \sin(2\Psi)\sin(\Delta)$ and $Ic = \sin(2\Psi)\cos(\Delta)$

The UVISEL Spectroscopic Phase Modulated Ellipsometer is a unique instrument that provides significant advantages for display applications when compared to conventional ellipsometers. Its technology is the most suitable for accurate thin film measurement on transparent substrates as the software includes advanced capabilities for automatic correction of backside reflections.

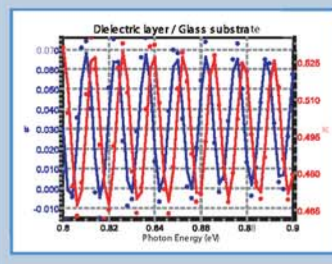
The spectral range of an ellipsometer is very important as it determines the possible applications. Characterization of plasma display panel materials such as ultra-thick dielectric layers is greatly enhanced by ellipsometric measurement in the NIR range.
Refractive index and thickness of each layer were extracted from the SE data analysis.
Each frame presents a model structure and the fitting results. For all models a roughness layer was used described by a 50/50 mixture of material+void based on the Effective Medium Approximation (EMA).

Roughness	379 Å
92% MgO + 8% void	621 Å
MgO	7472 Å
Glass	



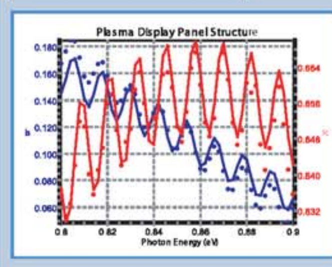
The MgO layer is strongly inhomogeneous in depth. Three layers with different proportions of MgO describe this sample, using the Effective Medium Approximation.

Roughness	140 Å
Dielectric	31.6 µm
Glass	



The fit was done over a reduced NIR range. The spectrum shows many interference fringes due to the ultra-thick dielectric layer.
The step size for spectrum acquisition is a very important parameter for obtaining well resolved interference fringes. Only a high resolution monochromator configuration can provide accurate characterization.
The optical properties of the dielectric layer on the reduced range have been determined using the fixed index dispersion formula with n = 1.767.

Roughness	660 Å
MgO	7760 Å
Dielectric	33.2 µm
Glass	



The full PDP structure was accurately characterized using the UVISEL NIR.
The measurement was performed on a reduced range from 0.8-0.9 eV with a step of 0.002 eV due to the ultra-thick structure.
The optical properties of the dielectric and MgO layers on the reduced range have been determined using the fixed index dispersion formula with respectively n=1.764 and n=1.642.

Conclusion

For multilayer structures it is always helpful and often necessary to know the properties of each film. Using the Jobin Yvon UVISEL NIR it is a straightforward procedure to investigate the thickness and optical properties of the complete PDP structure.
To ensure high yields in quality and quantity the FF-1000 ellipsometer is dedicated to the flat panel industries with a fully automated large area sample stage able to accept samples up to 1000 mm x 1000 mm.
This accurate, automated thin film metrology tool deliver both unique performance and proven reliability for on-line quality control of production processes.

France
Z.A. de la Vigne aux Loups
5, avenue Arago
91380 Chilly Mazarin
Tel: +33 (0)1 64 54 13 00
Fax: +33 (0)1 69 74 88 61
E-mail: tfd-sales@jobinyvon.fr

USA
3880 Park Avenue
Edison, NJ 08820
Tel: +1 732 494 8660
Fax: +1 732 494 8796
E-mail: info@jobinyvon.com

JY Germany: +49 (0)89 4623 17-0
JY Italy: +39 02 5760 3050
JY Japan: +81 (0)3 5667 7351
JY UK: +44 (0)20 8204 8142
JY China: +86 (0)10 6836 6542
JY Korea: +82 (0)2 576 8650