

The Thickness Measurement
Discussion for PI membrane in
Sensofar 3D Profiler
Sensofar 3D輪廓儀對於PI膜厚度測量
之探討

慶璇實業有限公司

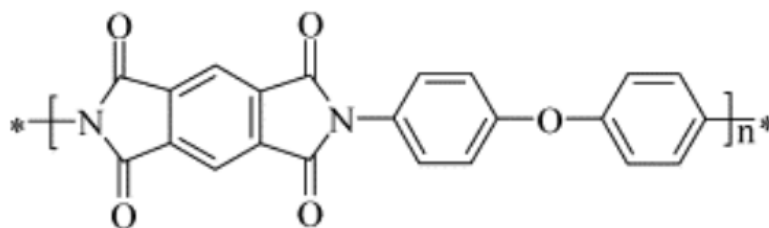
CHING SHUAN VISION
INDUSTRIES LTD

應用 謝嘉原

Application ChiaYuan Hsieh

PI (Polyimide Film) 膜是什麼...?

- 屬於環狀醯亞胺基團高分子聚合物 **聚醯亞胺 (Polyimide, PI)**，所製作的薄膜(**POLYIMIDE FILM; PI FILM**);
- PI薄膜算是目前開發出來最適合使用在電子材料中當作絕緣層的薄膜材料，具耐高低溫性、電氣絕緣性、黏結性、耐輻射性、耐介質性等特性;
- 其化學結構為:

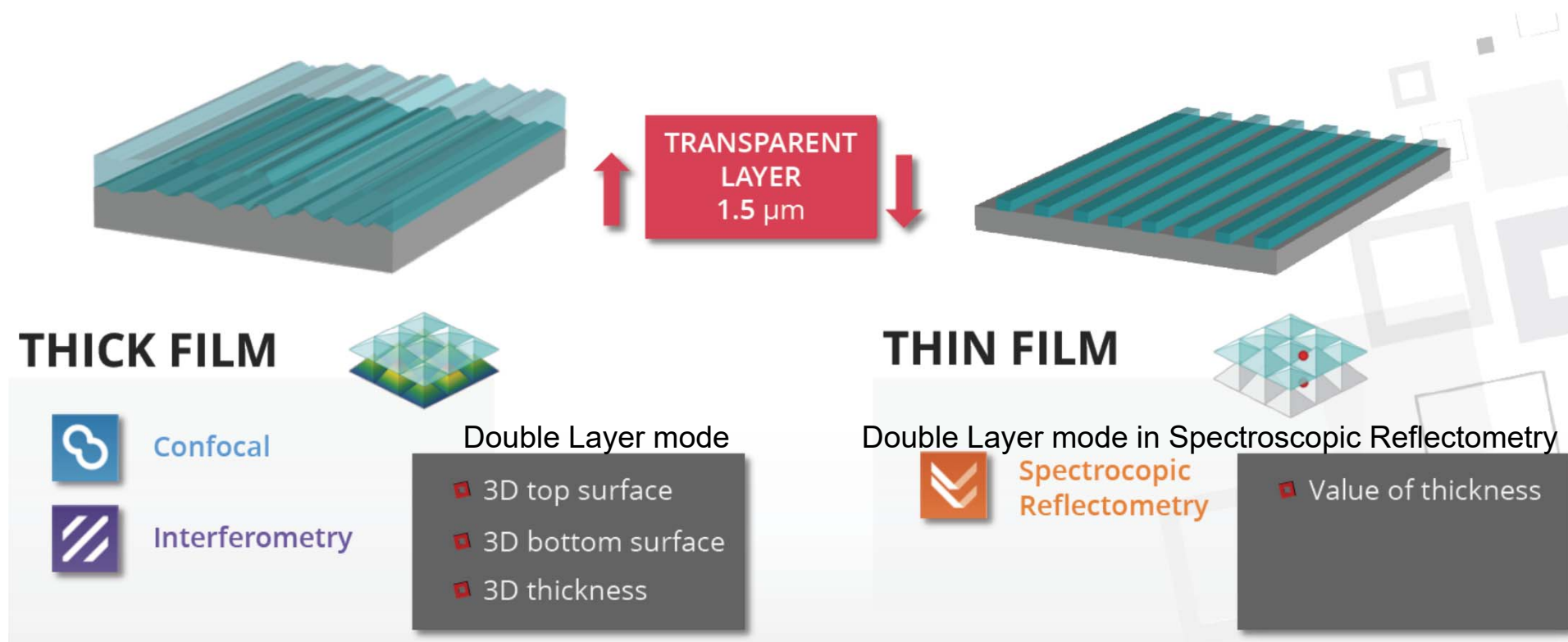


PI

PI 膜(Polyimide Film)使用在絕緣層製程之領域--

- PI膜早已泛用在航空航太、電氣（器）絕緣、液晶平面顯示、汽車工業、醫療領域、原子核能工業、太空衛星、海下核潛艇、微電子半導體及精密電子機械;
- 用於電子資通訊產品中的電子級PI薄膜 (透明PI膜)又被稱為「黃金薄膜」，是目前世界上性能最好的薄膜類絕緣材料之一
- 在電子材料領域，除了熟知的OLED, COF, FPC, PCB覆蓋層等，近年來也使用在先進的晶圓製程，石墨散熱片的原膜材料及5G通訊應用的改質PI材料

PI膜的測量討論1— Thick (厚膜) and Thin (薄膜)



- 以 $1.5\ \mu\text{m}$ 當分界點，大於 $1.5\ \mu\text{m}$ ，可以使用“雙層膜測量模式”測量，而薄膜則必需選購光譜分析儀串聯才能測量分析!
- 而Confocal (共軛焦)或Interferometry (干涉)模式的選擇則因膜的光穿透率差異來選擇，光穿透率高，建議使用Interferometry; 光穿透率低，則建議使用Confocal (共軛焦)模式

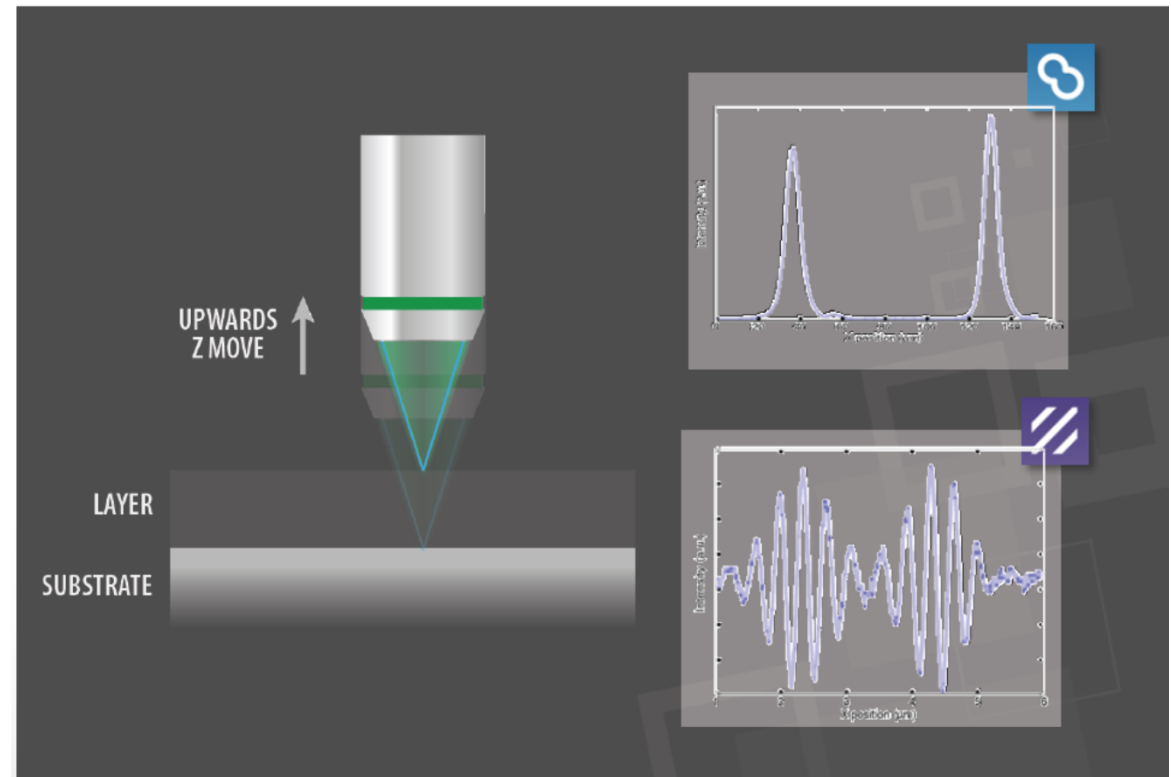
PI膜的測量討論2— 如何判斷可否測量厚膜(Thick Film)呢?

>假如**CSI**白光干涉模式下，有能力看到兩層的干涉條紋出現，代表白光干涉可以分析出此樣品的膜厚。

If **CSI (interferometric)** is capable of finding two focal point in this sample, the film should be used by double layers mode of **CSI**

>假如共軛焦的**SLIT**能夠找到兩層的對焦面，則代表共軛焦能夠分析出此樣品的膜厚。

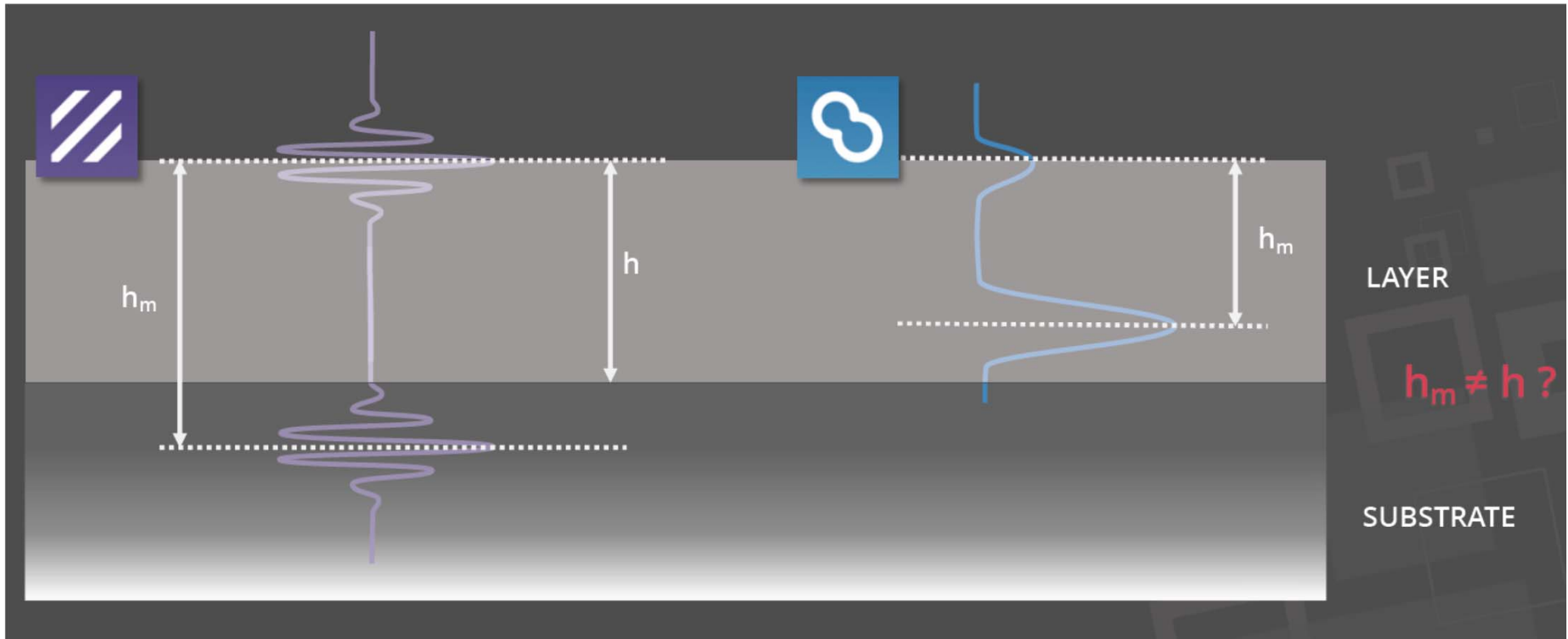
If **confocal** is capable of finding two focal surface in slit module, the film should be used by double layers mode of **confocal**.



PI膜的測量討論3—

The height of two focal Z position (h_m) is not the true height (h).

兩個對焦位置高度(h_m)不是真實的高度(h)。

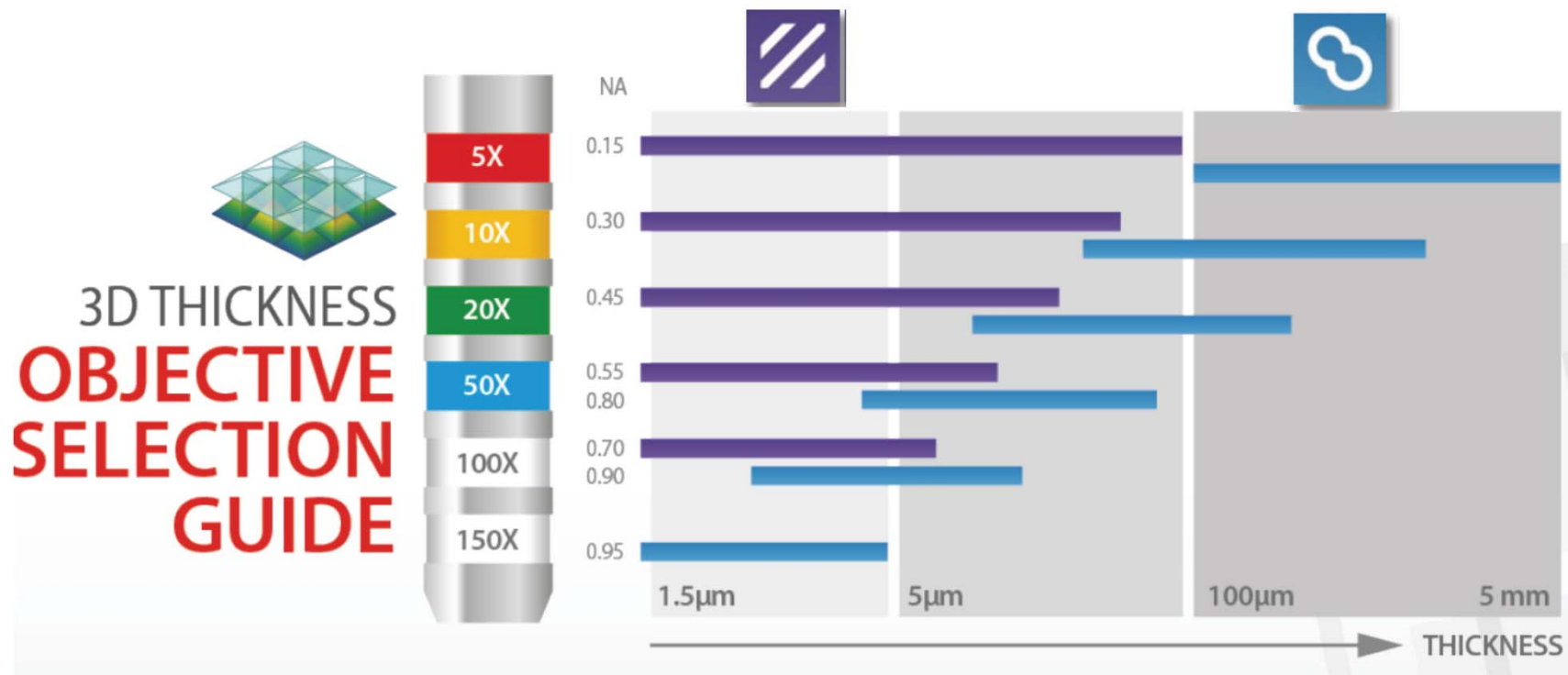


- 真實的高度(h)是要藉由雙層膜Z位置高度差(h_m)和折射率(N值)進行膜厚測量的補償。

[The true height (h) is compensated by the film measurement of two-layer focal Z positions (h_m) and refractive index (N value).]

PI膜的測量討論4—

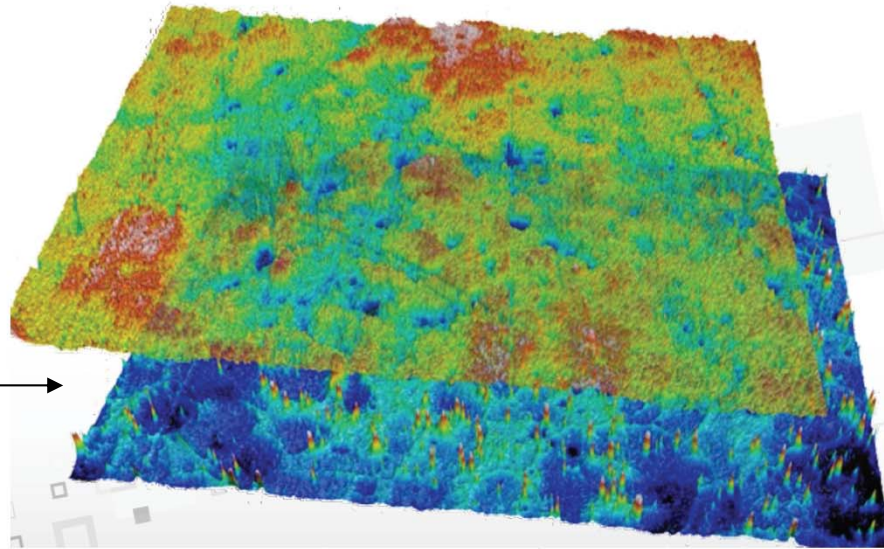
The appropriate thickness of PI corresponds to the right objective
PI膜厚測量應對應使用相對的物鏡



PS: 此圖表僅為建議測試依據，實際上還是得實測!

PI膜的測量討論5— 3D topography of ano-air and ano-aluminum topographies in interferometric (CSI) and confocal 電鍍鋁之空氣接觸面和鋁表面之3維拓譜圖

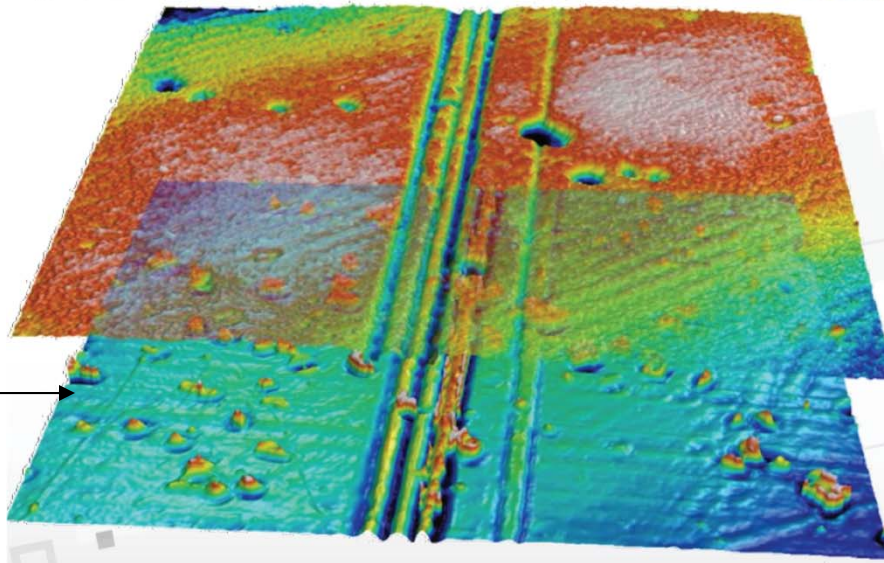
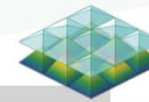
兩層中間為鋁的氧化層



After scanning the entire Z-range, we obtain a **3D IMAGE** composed of stacked images



CSI
20 X
0.40 NA



After scanning the entire Z-range, we obtain a **3D IMAGE** composed of stacked images



Confocal
100 X
0.95 NA



PI膜的測量討論6— Summary of film measure for PI membrane in Confocal/ Interferometry 在共軛焦/干涉之下，PI膜厚測量之總結

優點

PROS

- ✓ Topography of the layer can be obtained
- ✓ Layers from 1.5 μm to several mm can be measured

1. 兩層表面必需可以被觀測到;
2. 膜厚大於1.5 μm

缺點

CONS

- X Different objectives depending on the layer thickness
- X Only 1 transparent layer can be measured

1. 厚度測量被物鏡Z解析度限制;
2. 只有一層透明層 (兩個表面)可以測量

Thank you for your
attention..