國立聯合大學
111年度 重點發展計畫成果報告

計畫名稱：

中文：以外差干涉術製成相位式半導體疊對量測

計畫編號：RI111003

執行期間：111年1月1日至 至 111年12月 31日

計畫主持人：謝鴻志

執行系所：光電工程學系

Achievements of this Project (1)

- **2 SCI papers (投出並審稿中)**
  - **Hung-Chih Hsieh**, Meng-Rong Wu, and Xiang-Ting Huang, “Optimized Diffraction-based Overlay Target Design for Asymmetric Sidewall Structure by Quasi-period Linewidth Design with Finite-Difference Time-Domain Simulation”, **Optics Express (審稿中)**

    Acknowledgments. The authors would like to thank the National United University (NUU; Republic of China (Taiwan), Contract No. RI111003).
  - **Hung-Chih Hsieh** and Yi-Cong Gu, “Accurate Photomask Positioning in Advanced Lithography by Phase Detection of Heterodyne Interferometer”, **Applied Optics (審稿中)**

    Acknowledgments. The authors would like to thank the National United University (NUU; Republic of China (Taiwan), Contract No. RI111003).
- **4 International Conference paper (已發表)**
  - Yi-Cong Gu, En-Kai Cao, and **Hung-Chih Hsieh**, “Development of Photomask Positioning System by Diffraction-based Heterodyne Phase Measurement”, **Optics & Photonics Taiwan International Conference (OPTIC 2022), Dec., 2022.**
  - Bo-Rong Chen, Hung-Yu Chen, and **Hung-Chih Hsieh**, “Measurement Signal Enhancement of Diffraction-based Overlay Metrology by High-order Diffraction”, **Optics & Photonics Taiwan International Conference (OPTIC 2022), Dec., 2022.**
  - Chi-Ho Lee, Ying-Yu Lin, Sheng-Jie Yang, and **Hung-Chih Hsieh**, “Wafer Warpage Deformation Control by Low Temperature Cooling Plate System”, **Optics & Photonics Taiwan International Conference (OPTIC 2022), Dec., 2022.**
  - Meng-Rong Wu, Xiang-Ting Huang, Yu-Fen Dai, and **Hung-Chih Hsieh**, “Color-mixing Light Source and its Analysis Methodology by Sinusoidal Modulated Frequencies and Three-parameter Sine Fitting Algorithm”, **Optics & Photonics Taiwan International Conference (OPTIC 2022), Dec., 2022.**

    5. Acknowledgment

    The authors would like to thank the National United University (NUU; Republic of China (Taiwan), Contract No. RI111003)

Achievements of this Project (2)

- **聯大光電/台積電產學合作課程 x 3**

課程名稱	年級	時數	課程測驗通過率
光電量測原理與應用	大三~碩一	9 小時	77% (48/62)
積體電路工程	碩一	6 小時	100% (28/28)
光電實驗	碩一	6小時	進行中

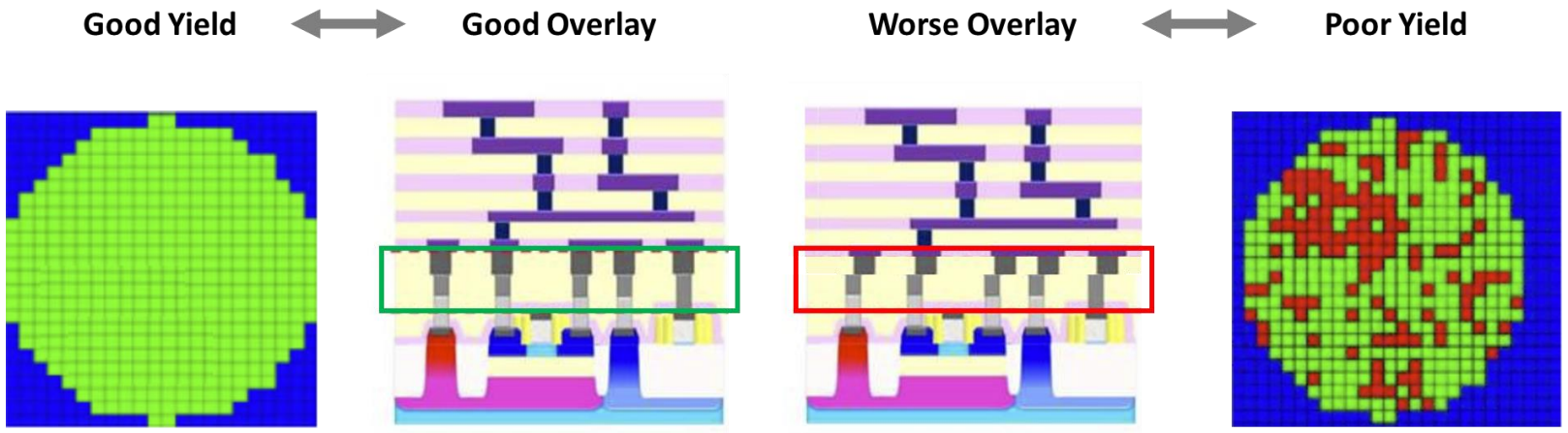
- **套裝實驗組 x 2**

實驗名稱	配合課程
基礎半導體繞射式疊層對準量測系統	光電量測原理與應用
相位型繞射式疊層對準量測系統	光電實驗

What is Overlay and its Impact?

- Lithography system → Linewidth (measured by SEM)

  → Position to expose (Alignment system)
- The alignment of upper and lower layer is called “overlay”
- Overlay measurement is the “eye” of the lithography
- Without overlay measurement, lithography system is blind



計畫摘要

問題描述

- 疊層對準量測目標其下之**鍍膜厚度不均勻**
- 厚度不均勻導致**量測誤差**

Goal

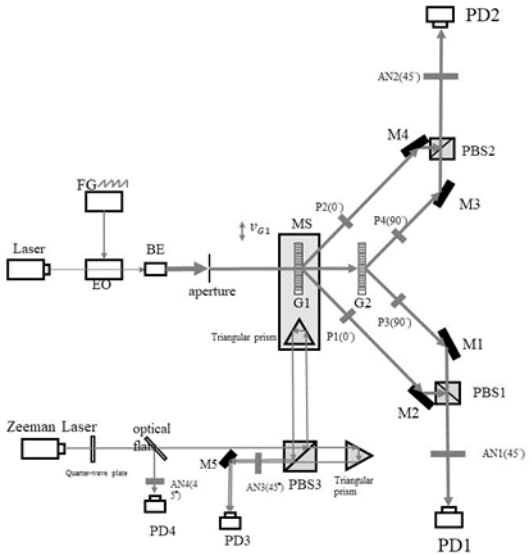
- **相位式量測**以避免厚度不均勻的影響
- **疊層對準量測誤差小於0.3nm**

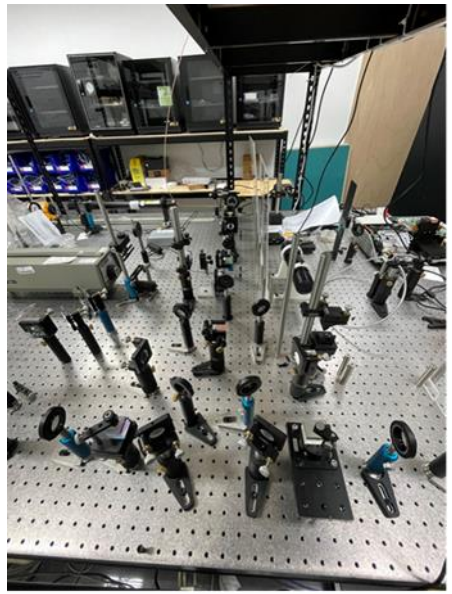
相位型繞射式疊層對準量測系統 (1)

- 量測系統建置
- 利用示波器擷取訊號並計算相位
- 利用移動光柵模擬不同疊層對準值

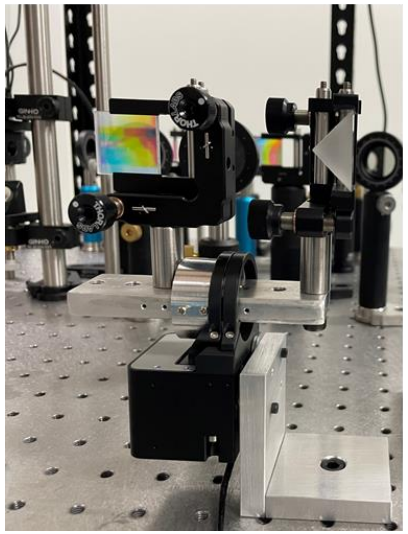
以示波器擷取干涉訊號

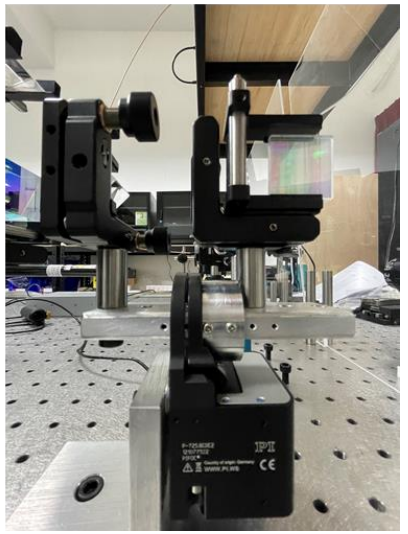
光學系統架構





移動光柵系統模擬不同疊層對準大小

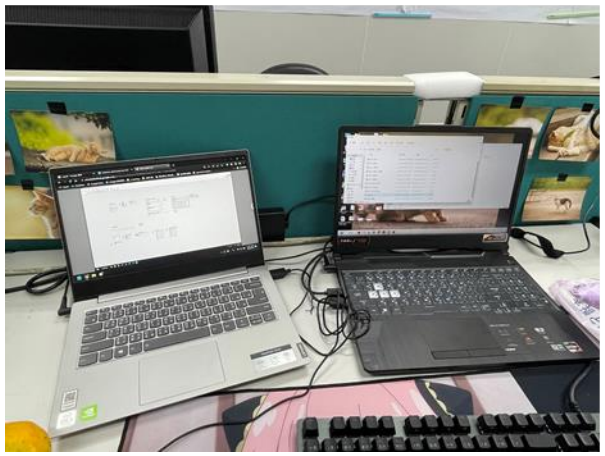


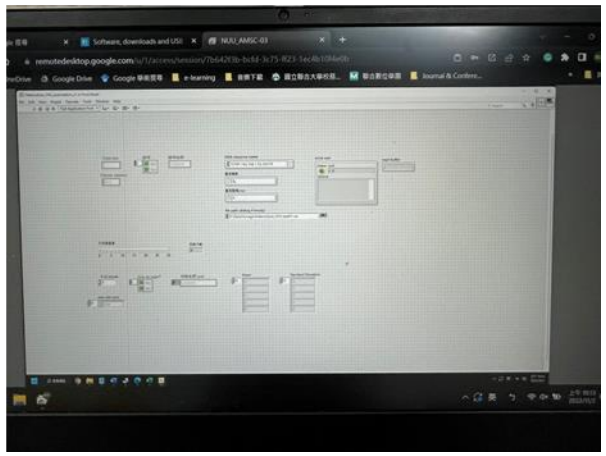


相位型繞射式疊層對準量測系統 (2)

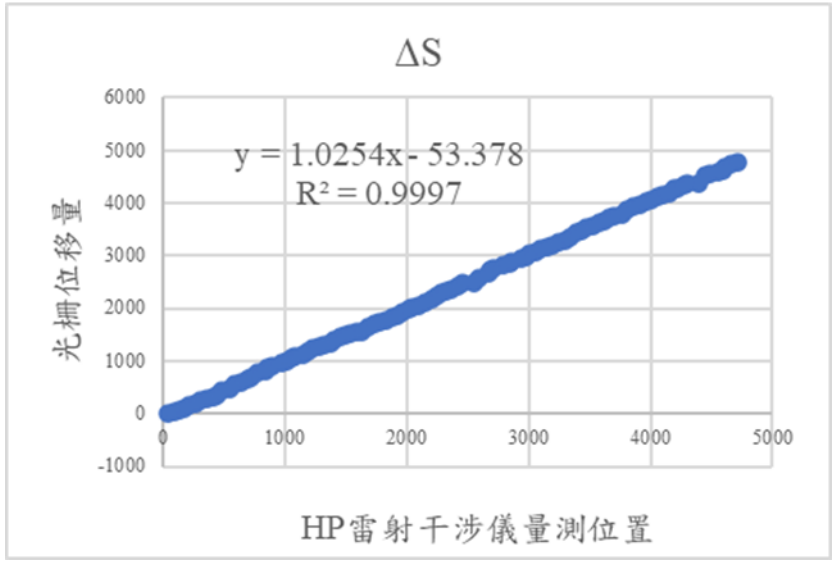
- 藉由LabVIEW程式，並且利用遠端連線的方式進行量測。減少量測時不必要的人為干擾，且自動化量測可以快速且精確地擷取所需數據。
- G1及G2兩光柵中間加入材質為SD，厚度為2.8mm的玻片。從圖中的結果可知，光的位移量為HP雷射干涉儀位移量的1.025倍，也就是當HP雷射干涉儀量測到10nm時，本計畫所量測的結果為10.25nm，誤差為0.25nm。

遠端自動化量測





實驗數據分析



聯大光電/台積電產學合作課程

- 3門課，共計21小時課程 (實作共6小時)
- 3門課經考核通過後，核發”半導體疊層對準基礎訓練”通過證書
- 課程邀請台積電業師授課(3~6小時)

與台積電討論課程內容

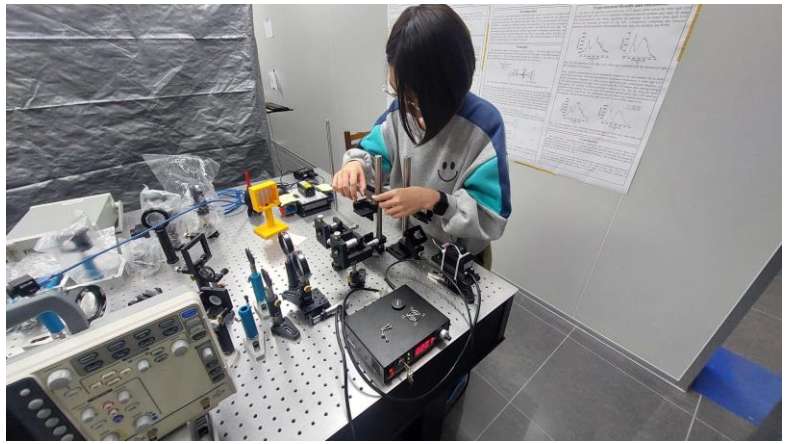
台積電業師授課(線上)

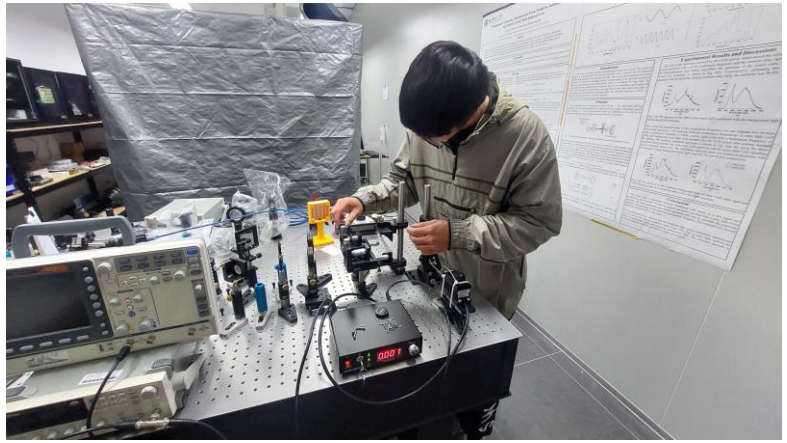
實作課程

套裝實驗組 -- 基礎半導體繞射式疊層對準量測系統

光學系統架構

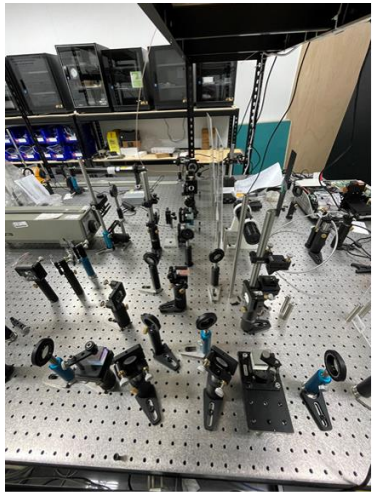
學生操作及教學

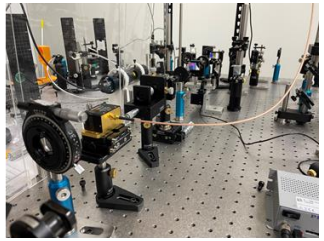


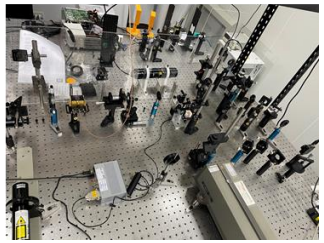


套裝實驗組 -- 相位型繞射式疊層對準量測系統

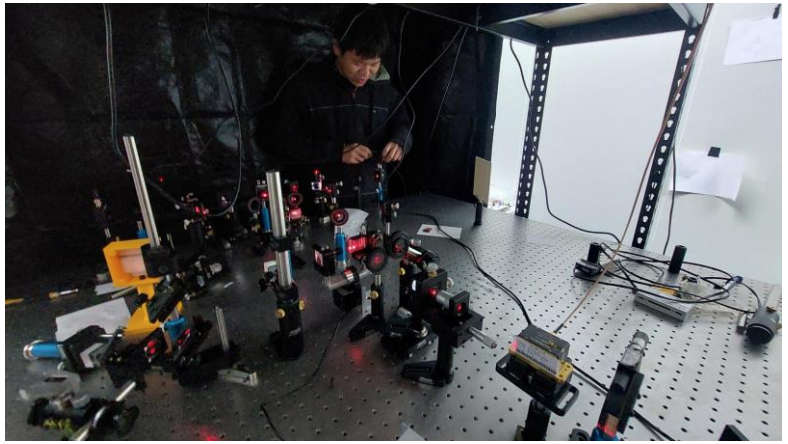
光學系統架構

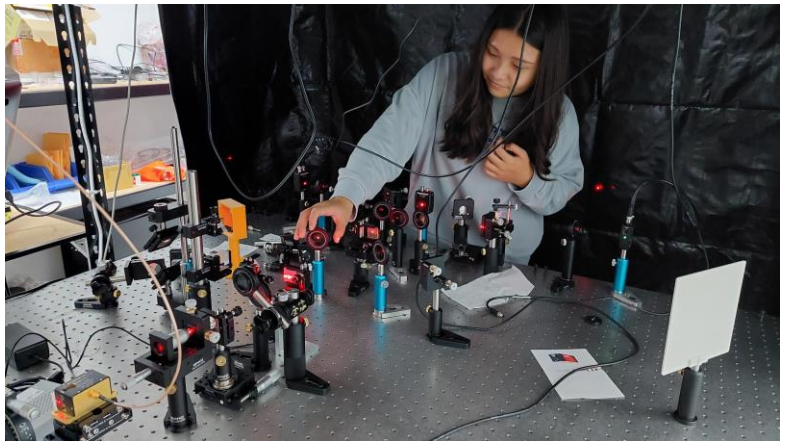






學生操作及教學





Thank You