“Application of machine learning based experimental design in selecting optimal substrate cleaning conditions” (基於機器學習的實驗設計方法於最佳基板清洗條件挑選之應用)

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This project will use automated optical inspection equipment to in-line measure the particle sizes on the substrate surface. We will present a hierarchical experimental design approach. Firstly, through the linear mixed effects model, the digital processing data collected from the cleaning machine are analyzed to find out the key factors that affect the particle removal rate. The established mixed effects model will also be used to estimate the remaining useful life of the cleaning material in order to replace the failed material in time. Then, using the machine learning based experimental design method (Bayesian optimization), under the condition of controlling the key factors affecting the particle removal rate, the optimal cleaning parameter setting is selected to achieve the purpose of speeding up the optimization time. The methods developed by this project can assist optoelectronic and semiconductor manufacturers in developing technologies such as automatic optical inspection and substrate cleaning processes to improve the reliability of optoelectronic products and make them internationally competitive.

Keywords: automated optical inspection; linear mixed effects model; machine learning; experimental design; optimal cleaning condition.

本計畫將利用自動光學檢測設備，進行線上的基板表面粒子尺寸量測。我們將提出一種階層式實驗設計方法。首先透過線性混合效用模型，來分析所收集的清洗機各項巨量數位化製程記錄資料，找出影響粒子移除率的關鍵因子。所建立的線性混合效用模型也將被用來推估清洗材料的剩餘壽命，以便於及時更換失效材料。接著運用基於機器學習的實驗設計方法(貝氏最佳化法)，在控制影響粒子移除率關鍵因子的條件下，挑選出最佳化的清洗參數設定，以達成以達到加快優化時間的目的。本計畫所發展的方法可運用於光電、半導體元件，協助廠商開發自動光學檢測、基板清洗製程等技術，提昇光電產品可靠度，使具有國際競爭力。

關鍵詞：自動光學檢測、線性混合效用模型、機器學習、實驗設計、最佳清洗參數組合。