THE STUDY OF IC PROCESS FAULT DETECTION

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ABSTRACT

THE EVOLUTION OF SEMICONDUCTOR MANUFACTURING PROCESS ON THE ENLARGEMENT OF WAFER SIZE TOGETHER WITH THE SHRINK OF FEATURE SIZE RESULTS IN THE DIFFICULTY OF PROCESS CONTROL. IN ADDITION, FAULTY PROCESSES RELATIVELY INCREASE. TIGHT PROCESS CONTROL THEN BECOMES AN ESSENTIAL REQUIREMENT IN THE FABS. UP TO THE PRESENT, SPC HAS BEEN USED AS A TOOL FOR QUALITY CONTROL. HOWEVER, MANY PROCESS PARAMETERS EXHIBIT CORRELATED RELATIONSHIP AND INEVITABLE STEADY DRIFT. USING SPC CONTROL CHARTS SOMETIMES LEADS TO FALSE ALARMS AND ERRONEOUS JUDGMENTS. THEREFORE, THE MAJOR MOTIVATION OF THIS RESEARCH IS TO LEARN THE CHARACTERISTICS OF THESE PROCESS VARIATIONS BY USING RADIAL BASIS FUNCTION (RBF) NEURAL NETWORKS. EQUIPMENT MALFUNCTION AND/OR THE FAULTS CAN THUS BE DETECTED AND THE FALSE ALARMS CAN BE AVOIDED. FURTHERMORE, THE MAINTENANCE CAN BE PERFORMED BASED ON OUR PROVIDED DIAGNOSIS FUNCTION IN ORDER TO PROMOTE THE OVERALL EQUIPMENT EFFECTIVENESS. RADIAL BASIS FUNCTION NEURAL NETWORKS HAVE THE CAPABILITY OF PARALLEL COMPUTATION. THE NEURAL NETWORKS ARE TRAINED BY THE INPUT-OUTPUT DATA SO THAT THE INTERNAL WEIGHTS OF NETWORKS CAN BE OBTAINED. THE CONSTRUCTED NON-LINEAR MODELS HAVE CHARACTERISTICS OF CURVE FITTING AND MAPPING RELATIONS. RBF NETWORKS CAN PROVIDE GENERALIZATIONS WITH MINIMUM STRUCTURES. THEREFORE, THEY ARE APPLICABLE TO THE COMPLICATED SYSTEMS, ESPECIALLY FOR THE PURPOSES OF FAULT DETECTION AND CLASSIFICATION.

Keywords: RADIAL BASIS FUNCTION NEURAL NETWORKS, FAULT DETECTION, STATISTICAL PROCESS CONTROL

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REFERENCES

10. 葉怡成, 類神經網路 識別及應用與實作, 五版, 儒林圖書出版, 台北市, 2001。
11. 蘇木春、張孝德，機器學習：類神經網路、模糊系統以及基因演算法則, 全華科技出版, 2000年。
12. 莊達人, VLSI製程技術, 高利圖書有限公司, 1995。
13. 廖德祿, 黃俊智, 類神經網路應用於非線性系統的適應控制, 成功大學工程科學研究所碩士論文, 1994。
14. 林宏達, 徐偉晉, 利用 RBF 網路與 SPCEPC 系統建構相關性製程回饋與管制模式 - 以積層陶瓷電容晶片切割作業為例, 朝陽科技大學工業工程與管理研究所碩士論文, 2001。