基于对角线的硅通孔容错设计

刘军 1, 2，董鹏 1, 2，任福继 3
(1 合肥工业大学 计算机与信息学院，安徽 合肥 230009;2 合肥工业大学 情感计算与先进智能机器安徽省重点实验室，安徽 合肥 230009;3 日本德岛大学 先端技术科学教育部，日本 德岛 7708502)

摘要： 三维集成电路通过使用硅通孔（through-silicon vias, TSV）作为垂直方向上芯片的通信链路，具有高密度，高带宽，低功耗等优点.由于 TSV 在制造和使用过程中可能会出现故障，导致整个三维芯片的故障.为了提高三维芯片的良品率，TSV 的良品率必须尽可能的提高.本文提出了一种新的基于对角线的 TSV 容错方案，并提出了基于最大流算法的故障修复算法，在 TSV 出现故障时使用对角线中的冗余 TSV 来修复故障 TSV 以提高整个三维芯片的良品率.实验结果表明，相比基于路由的容错方案，本文提出的基于对角线的 TSV 容错方案，芯片修复率可以达到 98.38%至 98.96%，方案造成的面积开销降低了 70%左右。

关键词： 硅通孔；对角线；故障修复

Diagonal-Based for TSV Fault Tolerance Design

LIU Jun1, 2, Dong Peng1, 2, REN Fu-ji3
(1 School of Computer and Information, Hefei University of Technology, Hefei 230009, China;2 Anhui Province Key Laboratory of Affective Computing and Advanced Intelligent Machine, Hefei University of Technology, Hefei 230009, China;3 Department of Information Science & Intelligent Systems, Faculty of Engineering, The University of Tokushima, Tokushima 7708502, Japan)

Abstract： Three dimensional integrated circuits, using through-silicon vias(TSVs) as the communication link between vertical chip, with the advantages of high density, high bandwidth and low power consumption. As the TSV during processing and using process may be failure, will lead to the entire three-dimensional chip failure. In order to improve the yield of 3D chips, the yield of TSV must be raised as much as possible. This paper presents a novel diagonal-based redundant TSV repair scheme and proposes a repair algorithm based on maximum flow algorithm to tolerance the faulty TSV with redundant TSVs in the diagonal to improve the yield of the entire three-dimensional chip. Experimental results show that the yield of the proposed repair strategy is 98.38% to 98.96% and the hardware overhead can be reduced by up to 70% compared to router-based technique.

Key words： through-silicon vias; diagonal-based; fault tolerance

作者简介：
刘 军 男，(1978-)，博士，副教授，硕士生导师. 研究方向为数字系统设计自动化、集成电路测试、嵌入式系统等.
董 鹏 (通讯作者) 男，(1992-)，硕士研究生. 研究方向为三维集成电路故测试与修复等.
E-mail:1796800781@qq.com.
任福继 男，(1959-)，博士，教授，博士生导师. 研究方向为人工智能、情感机器人、自然语言理解等.