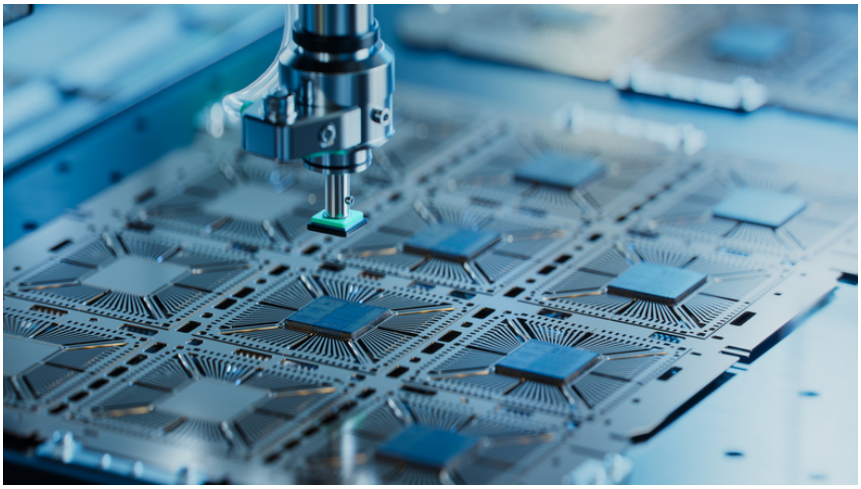
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Brick and Mortar Silicon Manufacturing

TECHNOLOGY NUMBER: 3623



OVERVIEW

Combine ASIC and FPGA strengths with reduced manufacturing and development costs

- Novel technique enables custom chip designs without high fixed or unit costs
- Application in chiplets, smartphones, custom electronics, and flexible digital circuits

BACKGROUND

Transistor scaling allows for increased chip performance and capabilities but adds significant costs related to design, validation, and production. Engineers must traditionally choose between two main methods: ASICs (Application-Specific Integrated Circuits) or FPGAs (Field-Programmable Gate Arrays). ASICs deliver high performance and enhanced power efficiency, crucial for high-demand applications like cell phones, but come with high initial costs and lack flexibility. Conversely, FPGAs offer in-field reprogrammability, accommodating changing standards and reducing initial expenses, but have higher per-unit costs and less efficiency. Current technology lacks a cost-effective solution combining both financial and technical advantages of ASICs and FPGAs. Hence, an advanced manufacturing technology that integrates the strengths of both is urgently needed to address these limitations and provide a balanced approach to custom chip production.

INNOVATION

Technology ID

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Category

Manufacturing Process
Engineering & Physical Sciences
Semiconductor, MEMS, and Electronics

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The University of Michigan researchers have developed the "brick and mortar" fabrication method that skillfully merges ASIC and FPGA benefits. The process involves two main components: mass-produced silicon 'bricks' containing various IP blocks like processor cores, memory arrays, and DSPs, and an I/O cap, termed 'mortar,' also mass-manufactured. Engineers assemble custom chips by selecting and arranging these pre-fabricated bricks into specific layouts, which are then bonded to the mortar I/O cap for interconnectivity. This technology drastically reduces overhead costs while closely achieving ASIC-level performance and retaining FPGA flexibility. Potential applications of this innovation include smartphone chip design, custom electronic solutions, and adaptable digital circuits, fulfilling industry demands for cost-effective yet high-performance chip manufacturing.

ADDITIONAL INFORMATION

REFERENCES:

Martha Mercaldi Kim, Mojtaba Mehrara, Mark Oskin, and Todd Austin, " Architectural implications of brick and mortar silicon manufacturing," ACM SIGARCH Computer Architecture News, Volume 35, Issue 2, Pages 244 - 253, doi: 10.1145/1273440.1250693

INTELLECTUAL PROPERTY:

US7598766 “Customized silicon chips produced using dynamically configurable polymorphic network”