

# Sustaining the Silicon Revolution: Challenges and Opportunities

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## **Abstract:**

Advances in microfabrication technology have continually yielded improvements in semiconductor integrated-circuit (IC) performance (speed) and cost per function over the past several decades, to usher in the Information Age. Gains in performance will not be as straightforward to achieve as they had been in the past, however, because fundamental materials and process limits are rapidly being approached. This paper will give an overview of IC technology trends and describe approaches to enhancing the functionality and lowering the cost of electronic systems, to usher in the age of ambient intelligence and ubiquitous computing. Opportunities for research will be described.

## **Glossary of Terms:**

*Semiconductor* — A material that is neither a good conductor of electricity (like copper) nor a good insulator (like rubber). The most common semiconductor material is silicon. The electrical conductivity of a semiconductor material can be modulated over a wide range by doping it with impurities or by subjecting it to an electric field.

*Transistor* — A device composed of semiconductor material that can be used to amplify an electrical signal or to open/close an electrical circuit.

*Integrated circuit* — An electronic circuit comprised of many components (transistors, resistors, capacitors, and/or inductors) fabricated on a single substrate, typically a comprised of semiconductor material.

## **CMOS:**

Complementary Metal Oxide Semiconductor. CMOS is a widely used type of silicon integrated-circuit technology that employs two types of transistors — NMOS (negative mobile charge) and PMOS (positive mobile charge) — which operate (switch on/off) in a complementary manner. The biggest advantage of CMOS technology over other types of IC technologies is that it consumes the least amount of power. This makes it particularly attractive for use in battery-powered devices, such as portable computers, cell phones, etc.

## **MEMS:**

Micro-Electro-Mechanical Systems. Electronic systems containing microscopic devices with both electrical and mechanical functionality for sensing and actuating.

## **Microfabrication:**

A batch manufacturing technology for making microscopic devices, such as integrated circuits or MEMS.