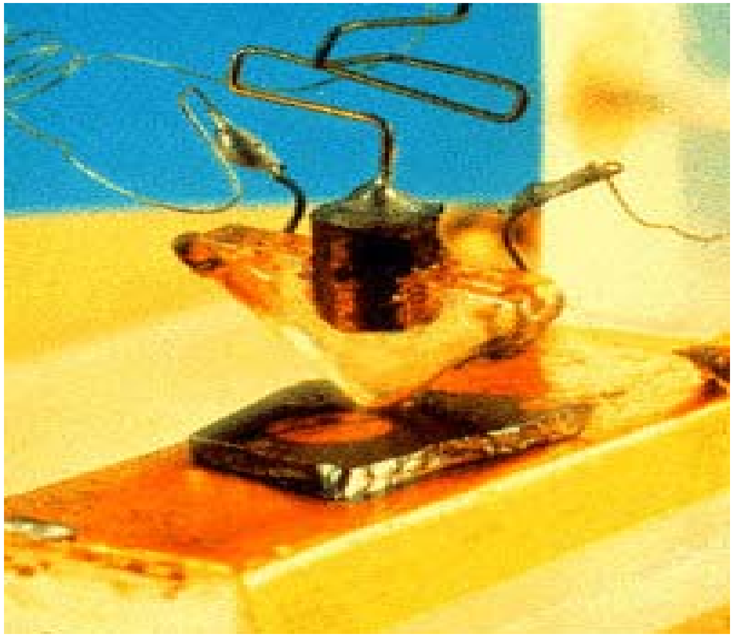
반도체와 재료공학

충남대 화공과
김 인호

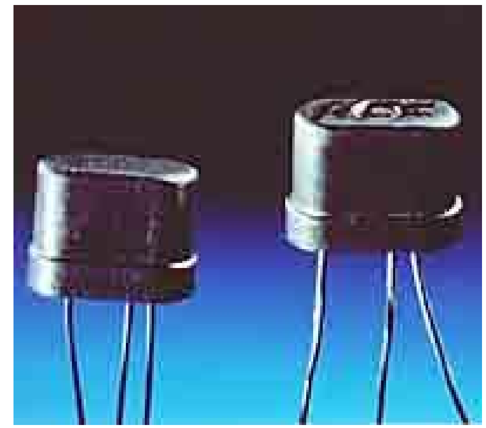
1947

- On December 23, William Shockley, Walter Brattain, and John Bardeen successfully tested this point-contact transistor, setting off the semiconductor revolution. Improved models of the transistor, developed at AT&T Bell Laboratories, supplanted vacuum tubes used on computers at the time.



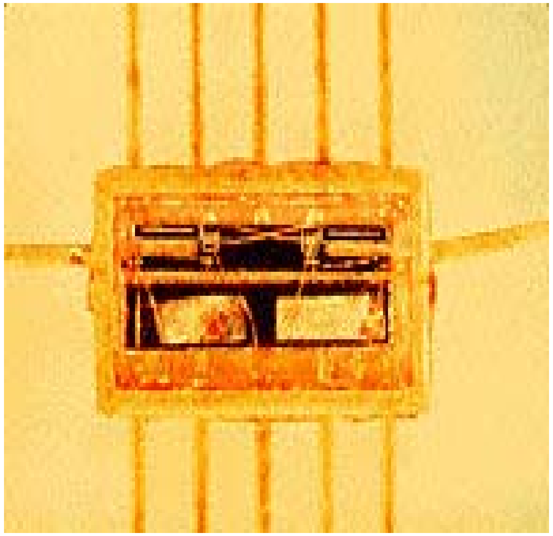
1954

- Silicon-based junction transistor, perfected by Gordon Teal of Texas Instruments Inc., brought the price of this component down to $2.50. A Texas Instruments news release from May 10, 1954, read, "Electronic "brains" approaching the human brain. Texas Instruments Incorporated of the first commercial production of silicon transistors kernel-sized substitutes for vacuum tubes."



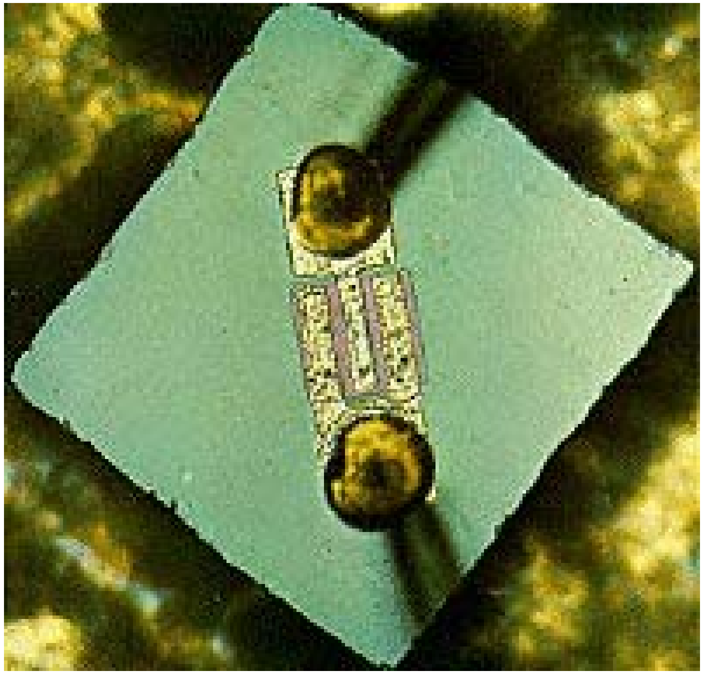
1958

- Jack Kilby created the first integrated circuit at Texas Instruments to prove that resistors and capacitors could exist on the same piece of semiconductor material.



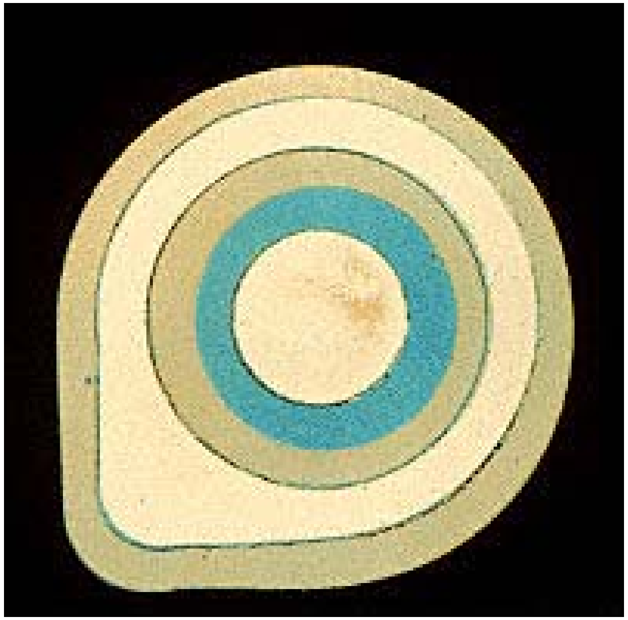
1962

- Fairchild Camera and Instrument Corp. produced the first widely accepted epitaxial gold-doped NPN transistor. The NPN transistor served as the industry workhouse for discrete logic



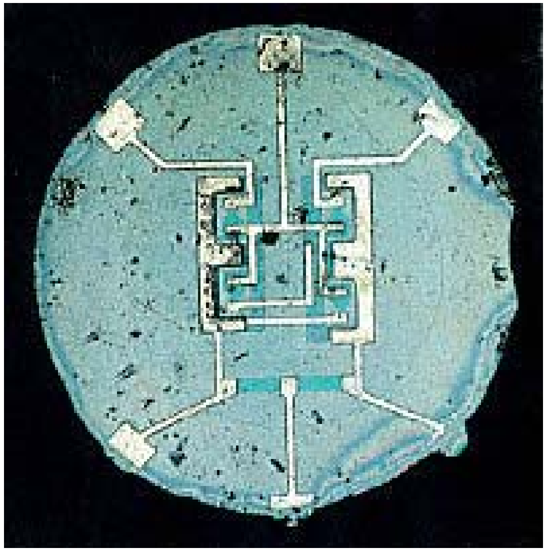
1959

- Jean Hoerni's Planar process, invented at Fairchild Camera and Instrument Corp., protects transistor junctions with a layer of oxide. This improves reliability and, by allowing printing of conducting channels directly on the silicon surface, enabled Robert Noyce's invention of the monolithic integrated circuit



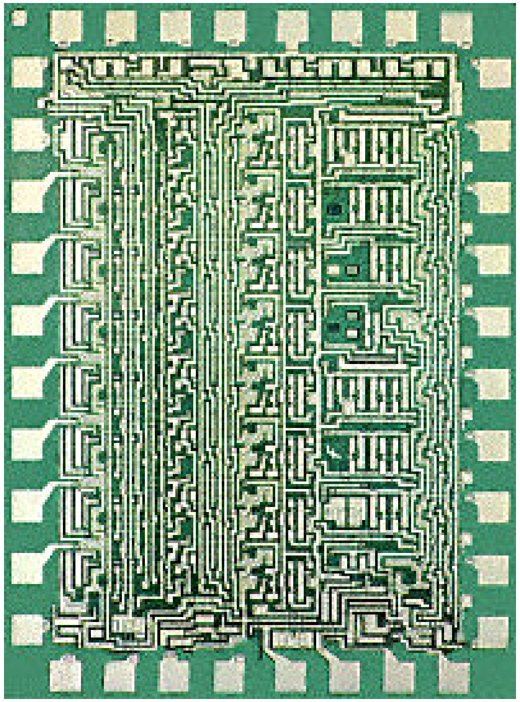
1961

- Fairchild Camera and Instrument Corp. invented the resistor-transistor logic (RTL) product, a set/reset flip-flop and the first integrated circuit available as a monolithic chip.



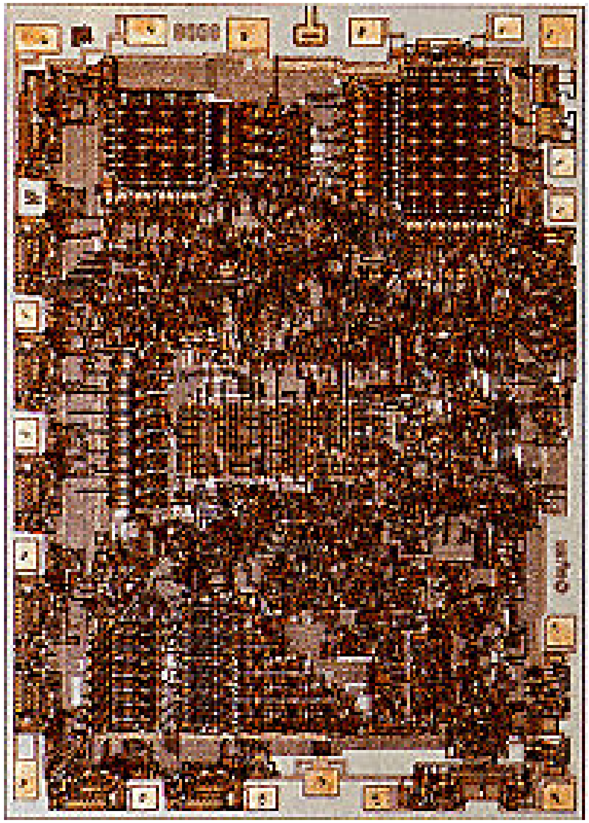
1967

- Fairchild Camera and Instrument Corp. built the first standard metal oxide semiconductor product for data processing applications, an eight-bit arithmetic unit and accumulator. In a MOS chip, engineers treat the semiconductor material to produce either of two varieties of transistors, called n-type and p-type.



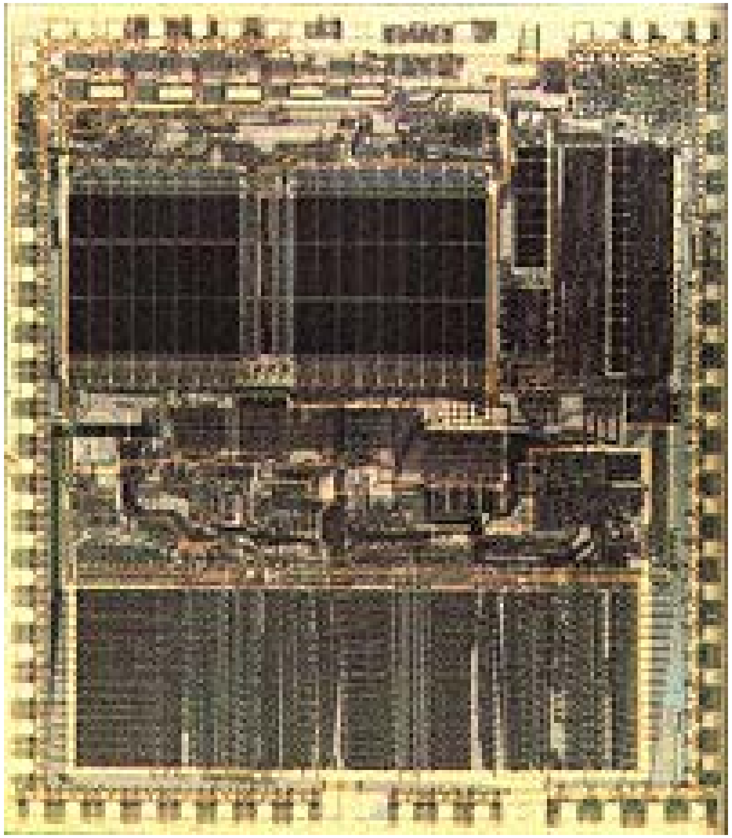
1972

- Intel´s 8008 microprocessor made its debut. A vast improvement over its predecessor, the 4004, its eight-bit word afforded 256 unique arrangements of ones and zeros. For the first time, a microprocessor could handle both uppercase and lowercase letters, all 10 numerals, punctuation marks, and a host of other symbols.



1979

- The Motorola 68000 microprocessor exhibited a processing speed far greater than its contemporaries. This high performance processor found its place in powerful work stations intended for graphics-intensive programs common in engineering.

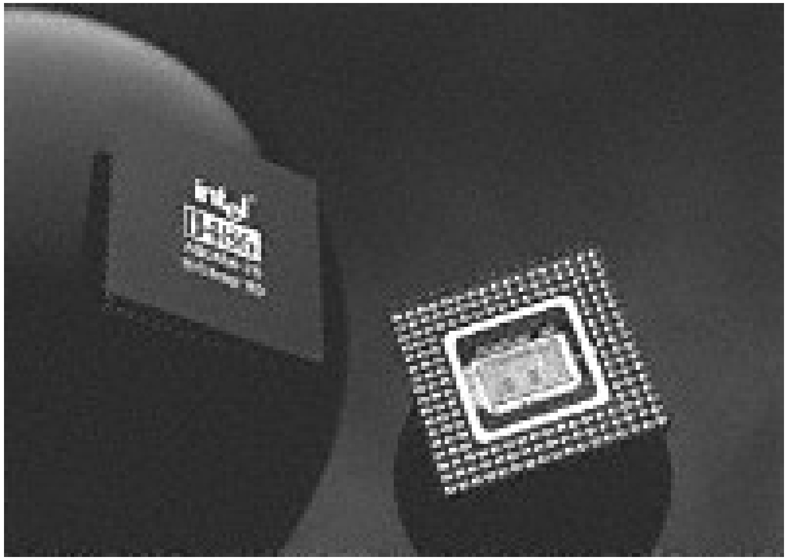


1986

- Compaq beat IBM to the market when it announced the Deskpro 386, the first computer on the market to use Intel´s new 80386 chip, a 32-bit microprocessor with 275,000 transistors on each chip. At 4 million operations per second and 4 kilobytes of memory, the 80386 gave PCs as much speed and power as older mainframes and minicomputers.

1989

- Intel released the 80486 microprocessor and the i860 RISC/coprocessor chip, each of which contained more than 1 million transistors. The RISC microprocessor had a 32-bit integer arithmetic and logic unit (the part of the CPU that performs operations such as addition and subtraction), a 64-bit floating-point unit, and a clock rate of 33 MHz.



- 1991 – 16Mbit DRAM

The 16Mbit DRAM was produced on a CMOS process with 3 to 4 polysilicon layers, 2 metal layers and 0.5μm minimum features. The resulting product had a 4.2μm2 memory cell size, a die size of approximately 130mm2 and sold for around $275 at introduction.

- 1993 – Intel PentiumTM

The Pentium is the first processor from Intel capable of executing more than 1 instruction per clock cycle. The Pentium was manufactured in a silicon gate BiCMOS process with 0.8μm linewidths, required 18 mask layers and had 1 polysilicon layer and 3 metal layers, the Pentium had 3.1 million transistors, a 60 to 66MHz clock speed and a 264mm2 die size.

- *1994 – Semiconductor Industry passes $100-billion.*

1993

- The Pentium microprocessor is released. The Pentium was the fifth generation of the ‘x86’ line of microprocessors from Intel, the basis for the IBM PC and its clones. The Pentium introduced several advances that made programs run faster such as the ability to execute several instructions at the same time and support for graphics and music.

- 1994 – 64Mbit DRAM

  The 64Mbit DRAM was produced on a CMOS process with 3 to 5 polysilicon layers, 2 to 3 metal layers and 0.35µm minimum features. The resulting product had a 1.5µm2 memory cell size, a die size of approximately 170mm2 and sold for around $575 at introduction. Later versions utilized smaller linewidths to shrink the die.

- 1995 – Intel Pentium Pro™

  The Pentium Pro introduced a dual cavity package with the Pentium Pro chip and a Cache chip housed together. The bus to the cache ran at the same speed as the processor. The Pentium Pro was manufactured in a silicon gate BiCMOS process with 0.35µm linewidths, required 20 mask layers and had 1 polysilicon layer and 4 metal layers, the Pentium Pro had 5.5 million transistors, a 150 to 200MHz clock speed and a 310mm2 die size.

- 1996 – 300mm silicon wafers introduced

- 1997 – Intel Pentium II™

The Pentium II introduced single in-line cartridge housing the processor chip and standard cache chips running at ½ the processor speed. The Pentium II was manufactured in a silicon gate CMOS process with 0.35µm linewidths, required 16 mask layers and had 1 polysilicon layer and 4 metal layers, the Pentium II had 7.5 million transistors, a 233 to 300MHz clock speed and a 209mm2 die size.

- 1998 – 256Mbit DRAM

The 256Mbit DRAM was produced on a CMOS process with 4 to 5 polysilicon layers, 2 to 3 metal layers and 0.25µm minimum features. The 256Mbit DRAM introduced the use of high-k dielectrics, although many parts are also produced without high-k, high-k dielectric represents the fourth major DRAM transition. The resulting product had a die size of approximately 204mm2 and sold for around $575 at introduction. Later versions utilized smaller linewidths to shrink the die.

- 1999 – Intel Pentium III™

- The Pentium III returned to a more standard PGA package and integrated the cache on chip. The Pentium III was manufactured in a silicon gate CMOS process with 0.18µm linewidths, required 21 mask layers and had 1 polysilicon layer and 6 metal layers, the Pentium III had 28 million transistors, a 500 to 733MHz clock speed and a 140mm2 die size.

The Chip-Making Process