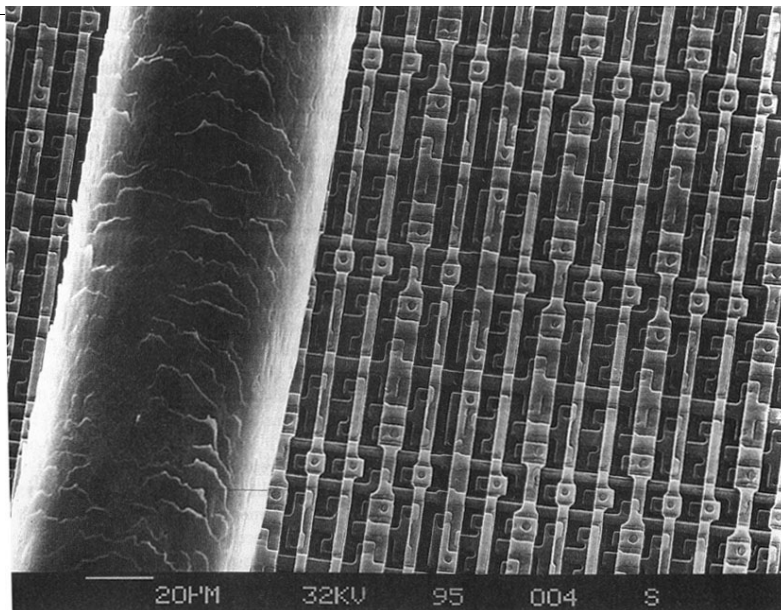

Introduction to Microelectronic Fabrication

Course Overview

Yao-Joe Yang

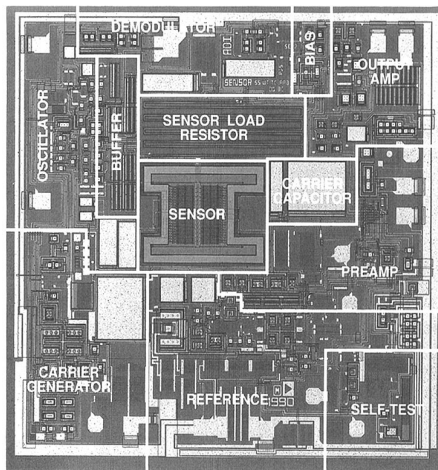
1

Integrated Circuits



2

ANALOG™ ADXL-50 ARCHITECTURE



~ 5 mm

- Mass production example. all components were integrated in to a chip

Analog Devices' ADXL-50, the industry's first surface micromachined accelerometer, includes signal conditioning on chip.

3

Semiconductor Devices

- Semiconductor industry is one of the most important industries in Taiwan
- Related product (e.g.)
 - computer chips (CPU, chipset, memory ...)
 - other ICs
 - communication devices
 - MEMS ?
- Production can be classified into 3 levels
 - electronics design
 - semiconductor fabrication
 - IC package

4

History of Semiconductor Devices

- 1890s
 - Mechanical tabulating machine
 - Herman Hollerith
 - Eventually IBM
- 1900s - 1950s
 - Vacuum tubes
- 1930s
 - Electromechanical computers
 - V. Bush at MIT
- 1940s
 - ENIAC, the first electronic computer

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History of Semiconductor Devices

- Dec. 23, 1947
 - The first transfer resistor (Transistor)
 - Bell Laboratory (AT&T → Lucent Tech)
 - Shockley, Bardeen, Brattin, 1956 Nobel Prize in physics
- Discrete devices (1950s)
 - one device per chip
 - transistor radios
- Integrated Circuits (ICs)
 - appeared in 1959, J. Kilby, TI, 2000 Nobel Prize in physics
 - 5 devices in the same element
 - wire individual elements in one

6

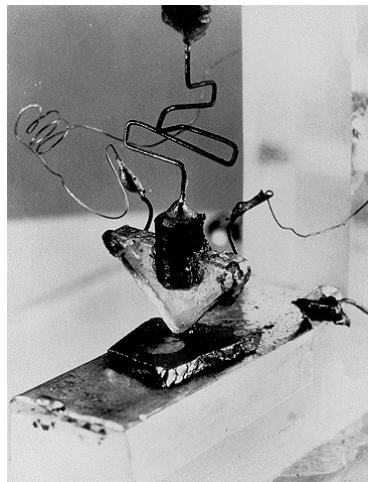
History of Semiconductor Devices

- Planar technology
 - Fairchild, N. Noyce & J. Horni
 - The method we used today
- Development of semiconductor industry
 - Schockly from Bell Lab to Palo Alto
 - the birth of “Silicon Valley”
 - Noyce, Moore, et. al → Intel
- Moore’s Law (1964)
 - Density of IC will double every 18 months

7

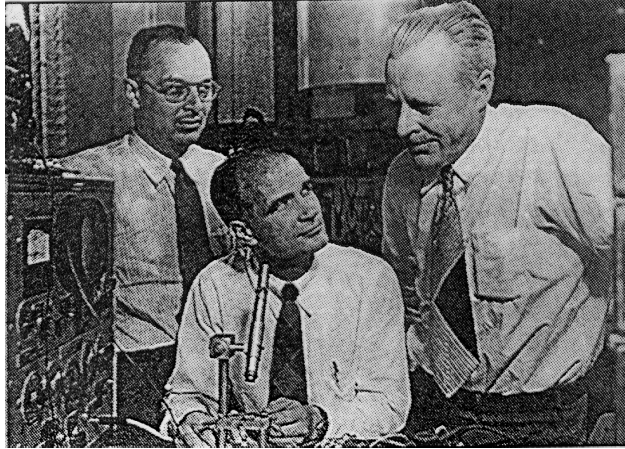
First Transistor, Bell Lab, 1947

Photo courtesy:
AT&T Archive



8

First Transistor and Its Inventors



John Bardeen, William Shockley and Walter Brattain

Photo courtesy: Lucent Technologies Inc.

9

First IC Device Made by Jack Kilby of Texas Instrument in 1958

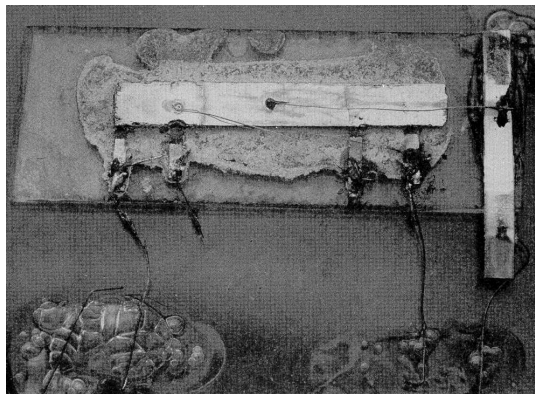


Photo courtesy: Texas Instruments

10

First Silicon IC Chip Made by Robert Noyce of Fairchild Camera in 1961

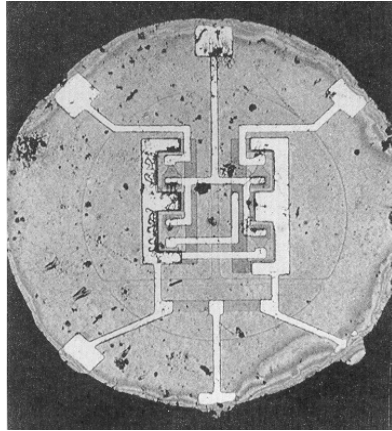
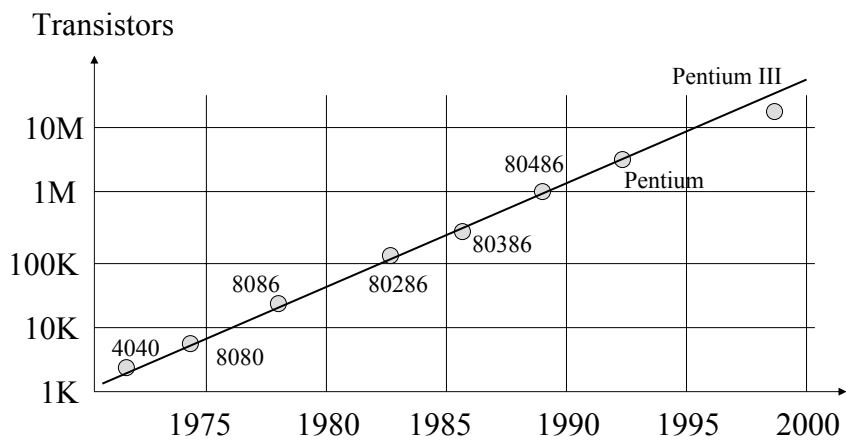


Photo courtesy: Fairchild Semiconductor International

11

Moore's Law, Intel's Version



12

History of Semiconductor Devices

- ENIAC 1947
 - size 30 x 50 ft²
 - weight 30 tons
 - vacuum tubes 18,000
 - resistor 70,000
 - capacitor 10,000
 - switches 6000
 - power 150,000 W
 - Cost (1940) \$400,000
- Same function can be achieved by a 1.5×1.5 cm² die in mid 1970s !

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IC Industries

- Raw material supplier
 - wafers, chemicals
- IC circuitry design
 - Design house
- IC fabrication
 - E.g., TSMC, UMI for fab only
 - E.g., Intel, TI, Lucent for both design and fabrication
- Equipment suppliers of IC fabrication/characterization
 - CVD system, lithography, CMP
 - E.g., Applied Materials, KLA-Tencor, Nikon

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Semiconductor Devices

- Resistor
- diode
- transistor
- capacitor

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What You Will Learn ?

- An overall idea on how a IC chip was fabricated
- Certain depth on each important fabrication step
- The role of a non-electrical engineering background person in semiconductor industries or related research projects

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Courses after this introductory material

- Semiconductor fabrication related courses
- MEMS related courses
- nanosystems related courses
- semiconductor processes