

# Introduction to Semiconductor Manufacturing Technology

## Chapter 1, Introduction

Hong Xiao, Ph. D.  
hxiao89@hotmail.com

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

1

## Objective

After taking this course, you will able to

- Use common semiconductor terminology
- Describe a basic IC fabrication sequence
- Briefly explain each process step
- Relate your job or products to semiconductor manufacturing process

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

2

## Topics

- Introduction
- IC Device and Design
- Semiconductor Manufacturing Processes
- Future Trends

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

3

## Introduction

- First Transistor, AT&T Bell Labs, 1947
- First Single Crystal Germanium, 1952
- First Single Crystal Silicon, 1954
- First IC device, TI, 1958
- First IC product, Fairchild Camera, 1961

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

4

## First Transistor, Bell Lab, 1947

Photo courtesy:  
AT&T Archive



Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

5

## First Transistor and Its Inventors



John Bardeen, William Shockley and Walter Brattain

Photo courtesy: Lucent Technologies Inc.

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

6

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



Photo courtesy: Texas Instruments

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

7

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

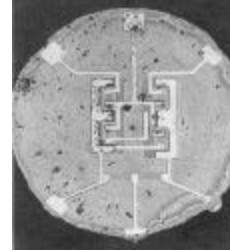


Photo courtesy: Fairchild Semiconductor International

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

8

## Moore's Law

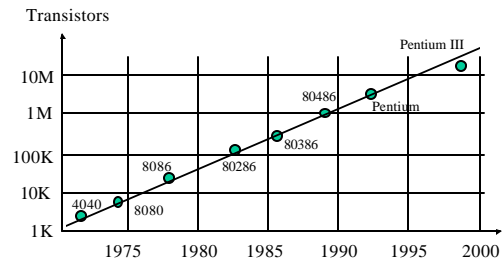
- Intel co-founder Gordon Moore notice in 1964
- Number of transistors doubled every 12 months while price unchanged
- Slowed down in the 1980s to every 18 months
- Amazingly still correct, likely to keep until 2010.

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

9

## Moore's Law, Intel's Version



Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

10

## IC Scales

Integration level	Abbreviation	Number of devices on a chip
Small Scale Integration	SSI	2 to 50
Medium Scale Integration	MSI	50 to 5,000
Large Scale Integration	LSI	5,000 to 100,000
Very Large Scale Integration	VLSI	100,000 to 10,000,000
Ultra Large Scale Integration	ULSI	10,000,000 to 1,000,000,000
Super Large Scale Integration	SLSI	over 1,000,000,000

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

11

## Road Map Semiconductor Industry

	1995	1997	1999	2001	2004	2007
Minimum feature size ( $\mu\text{m}$ )	0.35	0.25	0.18	0.13	0.10	0.07
DRAM Bits/chip	64 M	256 M	1 G	4 G	16 G	64 G
Cost/bits @ volume (millicents)	0.017	0.007	0.003	0.001	0.0005	0.0002
Microprocessor Transistors/cm <sup>2</sup>	4 M	7 M	13 M	25 M	50 M	90 M
Cost/Transistor @ volume (millicents)	1	0.5	0.2	0.1	0.05	0.02
ASIC Transistors/cm <sup>2</sup>	2 M	4 M	7 M	13 M	25 M	40 M
Cost/Transistor @ volume (millicents)	0.3	0.1	0.05	0.03	0.02	0.01
Wafer size (mm)	200	200	200 - 300	300	300	300 - 400 (?)

Hong Xiao, Ph. D.

www2.austin.cc.tx.us/HongXiao/Book.htm

12

