DEVICE TECHNOLOGY & PACKAGING

- MOS devices
- Design and layout considerations
- Silicon Bipolar technology
- GaAs and other III-V devices
- Packaging
- Reliability

Chapters 8 – 10 in Jaeger ”Introduction to Microelectronic Fabrication”

Silicon Bipolar Technologies

Bipolar transistors today used for:

- **Analog circuits**
- **High frequency**
- **Power devices**

- **Simple Bipolars using ”CMOS-like” process**
- **Reduce collector resistance by ”buried collector” (need epi-reactor)**
- **Add poly-emitter to increase gain**
- **BiCMOS process combines CMOS and Bipolar on same chip =>**
  Very complex process, up to 30 mask layers

10.6.6 Lateral *pnp* Transistors

The lateral *pnp* structure in Fig. 10.14 provides a transistor with uncommitted collector, base, and emitter contacts. The emitter and collector are formed from the *p*-type region that is used for the base of the *npn* transistor. The basewidth is determined by the lithographic spacing between the two diffusions plus the degree of lateral diffusion

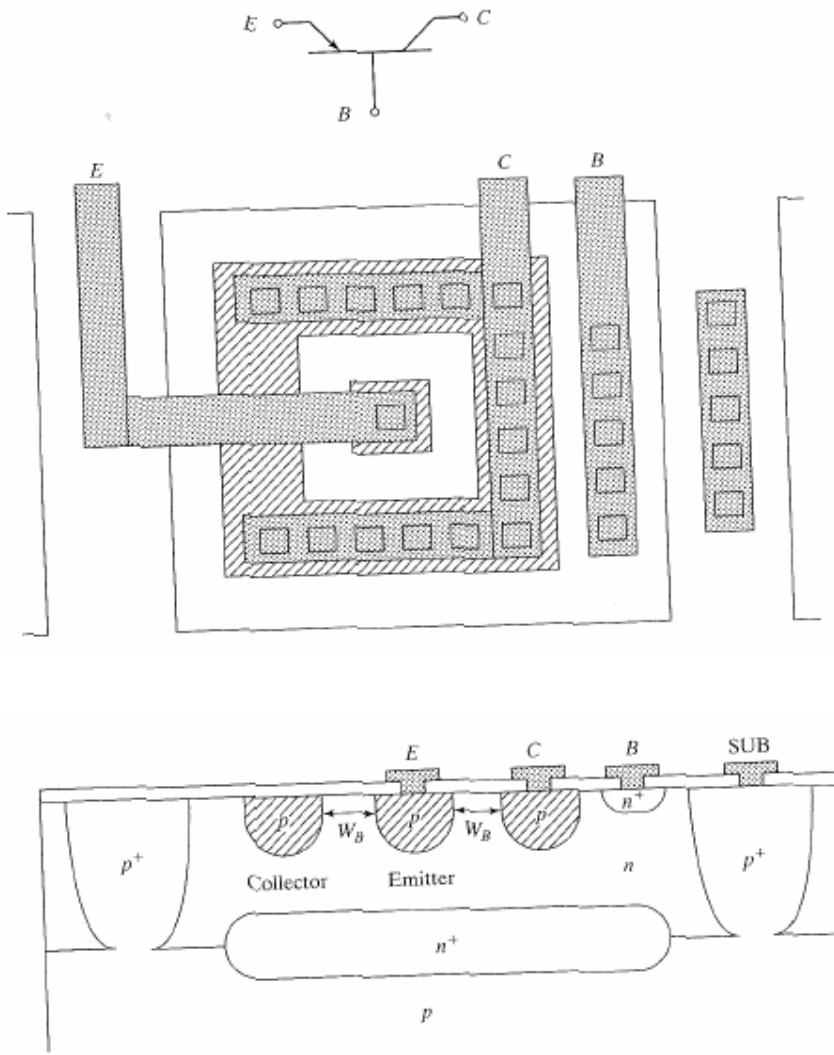


FIGURE 10.14
Enclosed lateral *pnp* transistor structure.

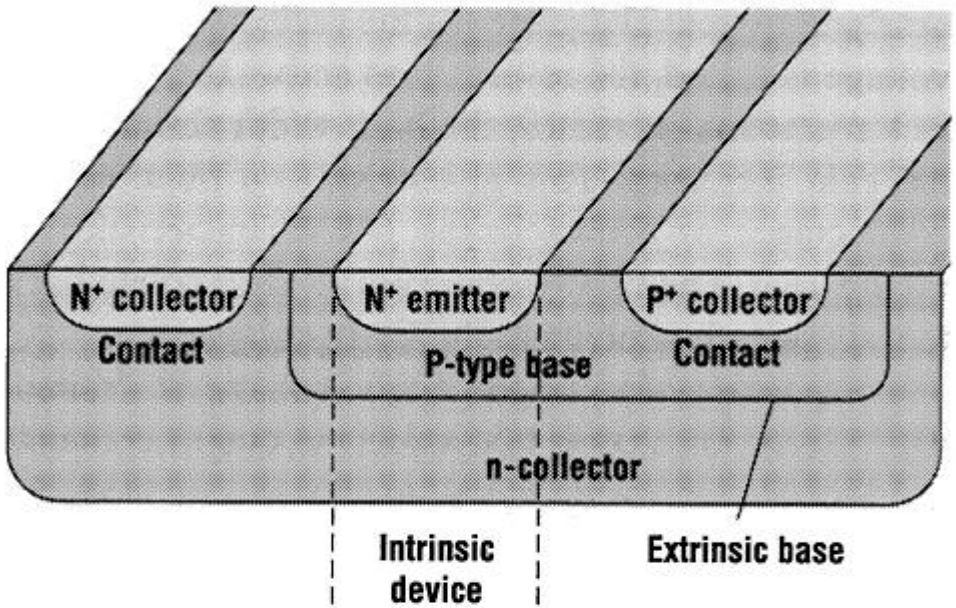


Figure 18.1 Cross-sectional view of a simple bipolar transistor showing the active or intrinsic device region and the parasitic or extrinsic regions

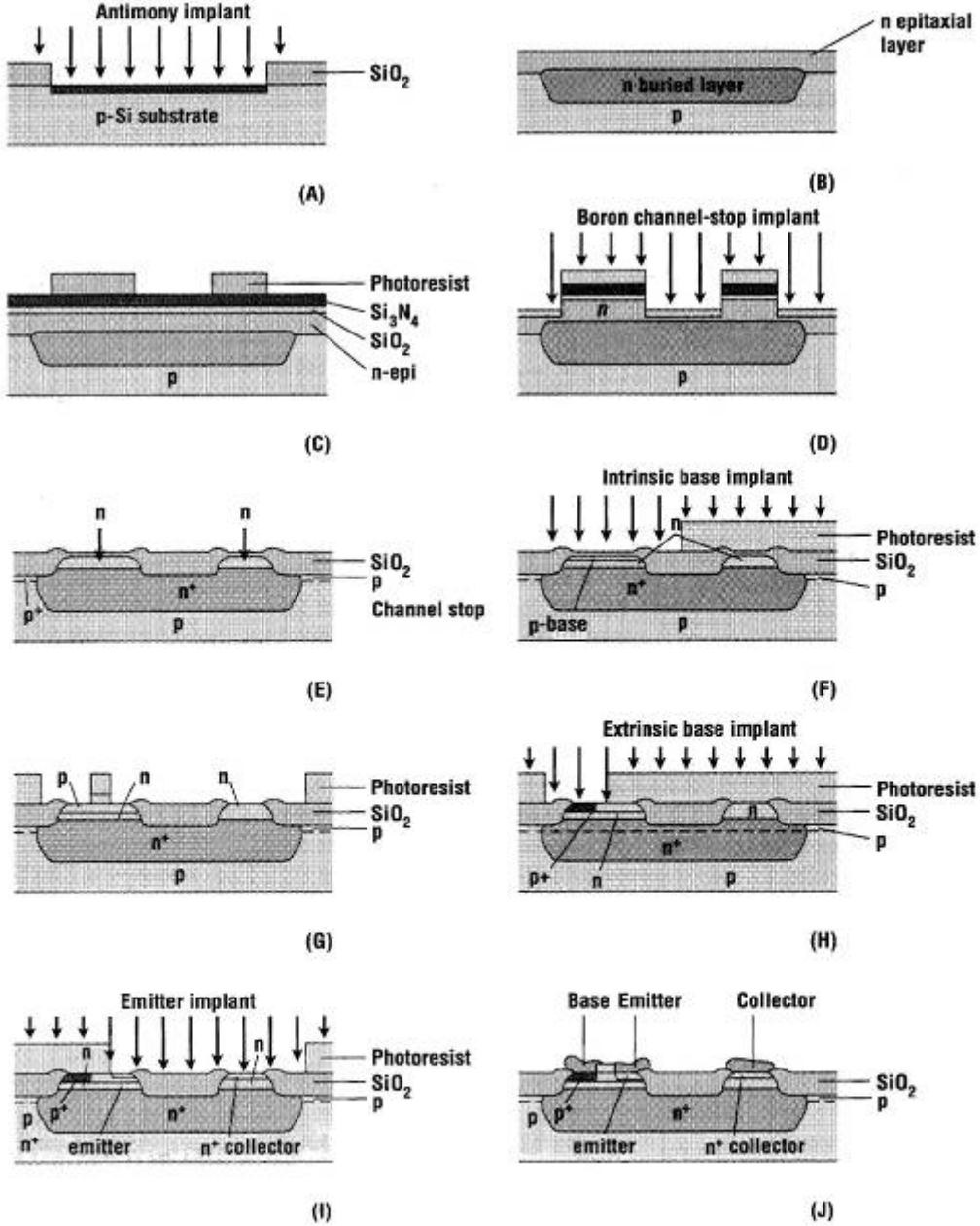


Figure 18.9 Process flow for an oxide isolated triple-diffused bipolar technology without sinkers. Steps include (A) buried layer formation, (B) epitaxial growth, (C) LOCOS patterning, (D) silicon recessing and channel stop implants, (E)local oxidation, (F) intrinsic base implant, (G) contact mask, (H) extrinsic base implant, (I) emitter and collector contact implant, and (J) metallization *(after Sze, reprinted by permission of John Wiley & Sons).*

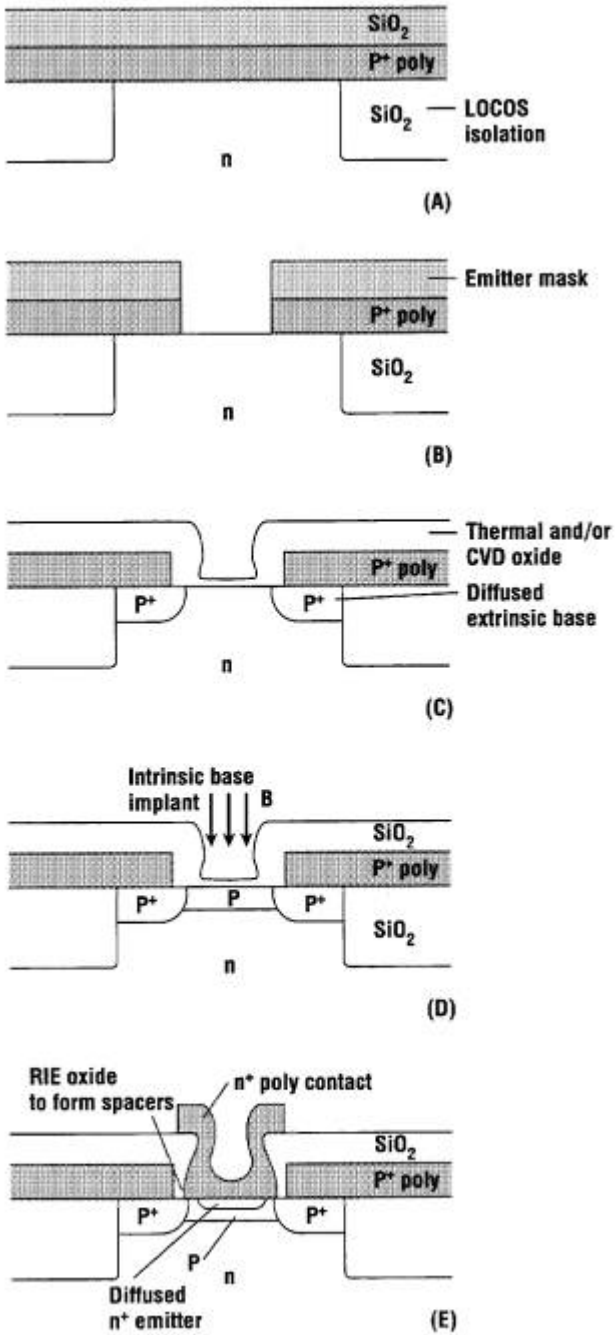


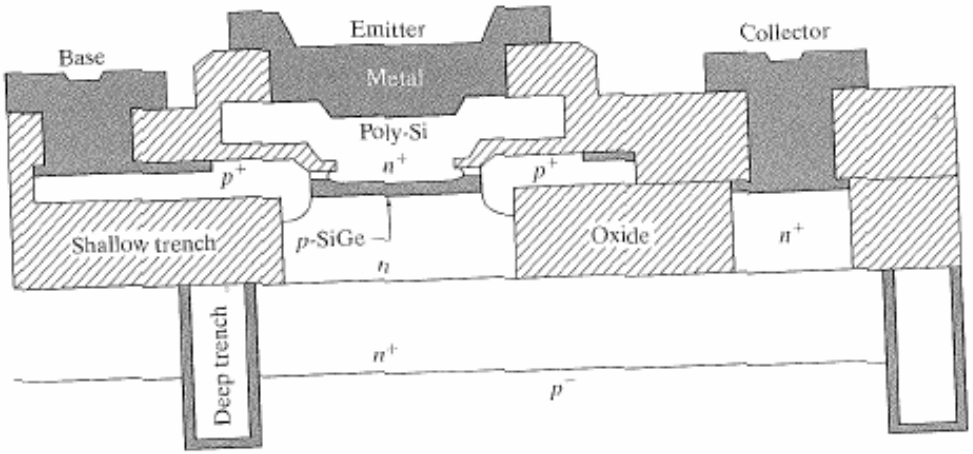
Figure 18.11 Simple process flow for a self-aligned double-poly bipolar technology.

Silicon Bipolar Technologies

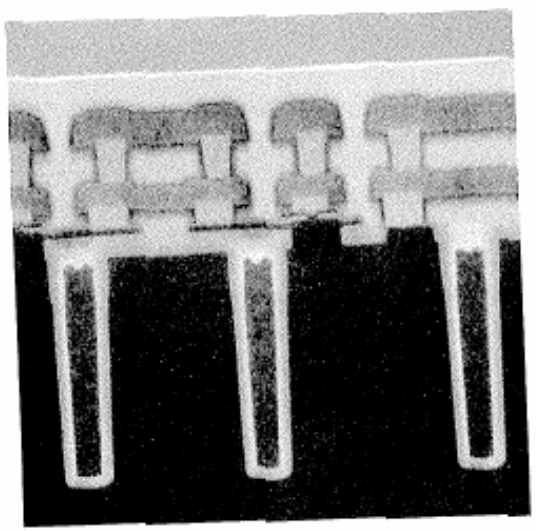
Common improvement today:

Silicon-Germanium Epitaxial Base Transistor

- **Modify bandgap by ~ 15% Ge in base region**
- **Increase in gain and max frequency**


Emitter
Metal
Collector
Base
Poly-Si
p^+
n^+
p^+
Shallow trench
p-SiGe
n
Oxide
n^+
Deep trench
n^+
p^-

(a)



(b)