DEVICE TECHNOLOGY & PACKAGING

Göran Alestig

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

MC2

GaAs and other III – V technologies

- No insulating oxide
- MESFET => Schottky contact on gate
- Can use semi-insulating high-resistivity substrate
- High electron mobilty => high speed devices
- Direct bandgap => opto devices

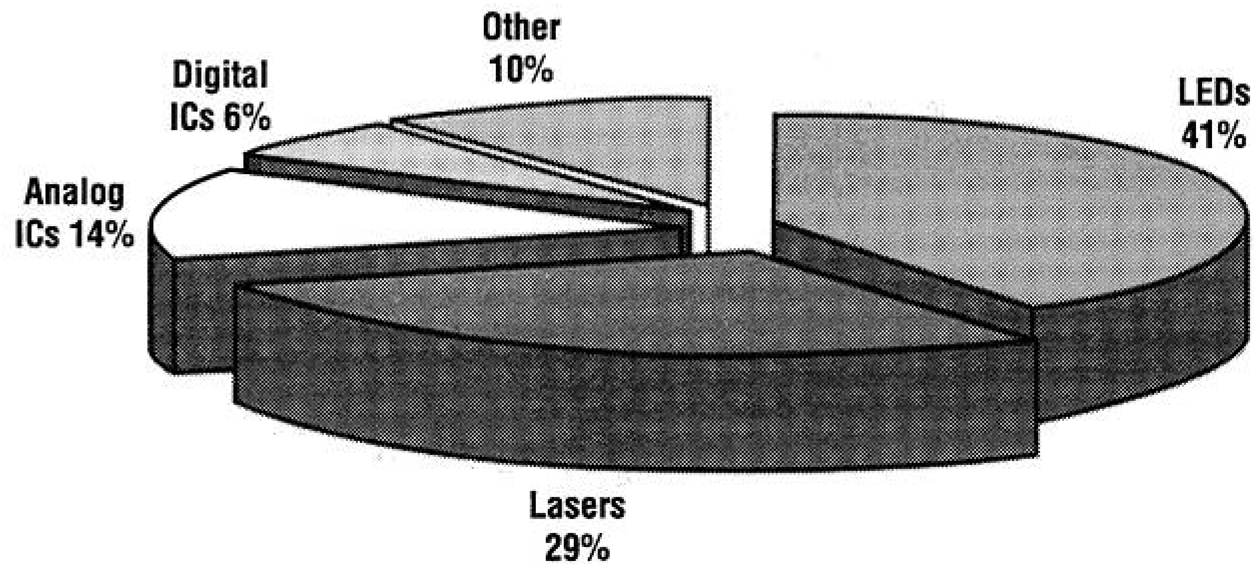


Figure 17.1 Pie diagram of application areas for compound semiconductor devices.

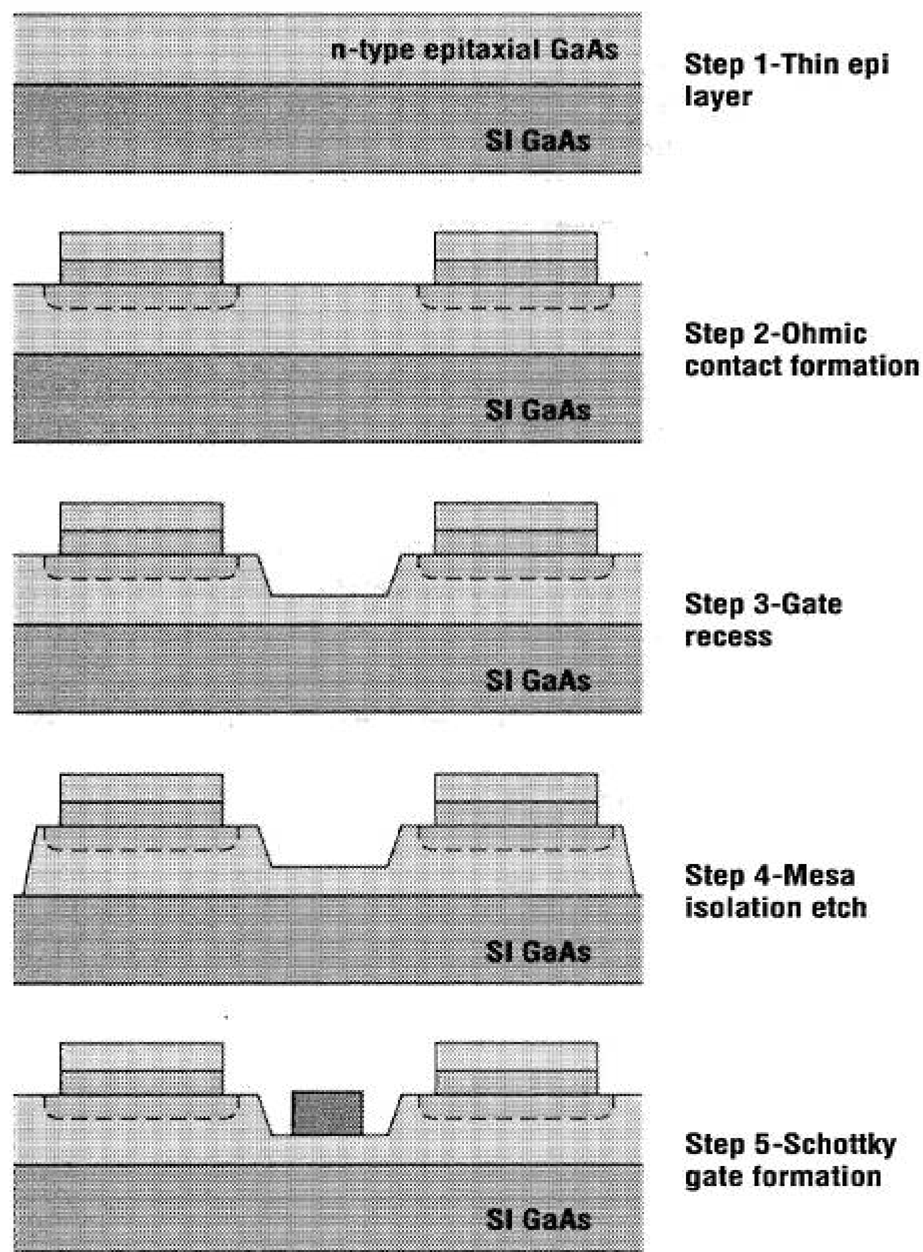


Figure 17.3 Process flow for a simple mesa-isolated MESFET. The first step can be replaced with an Si implant and anneal as discussed.

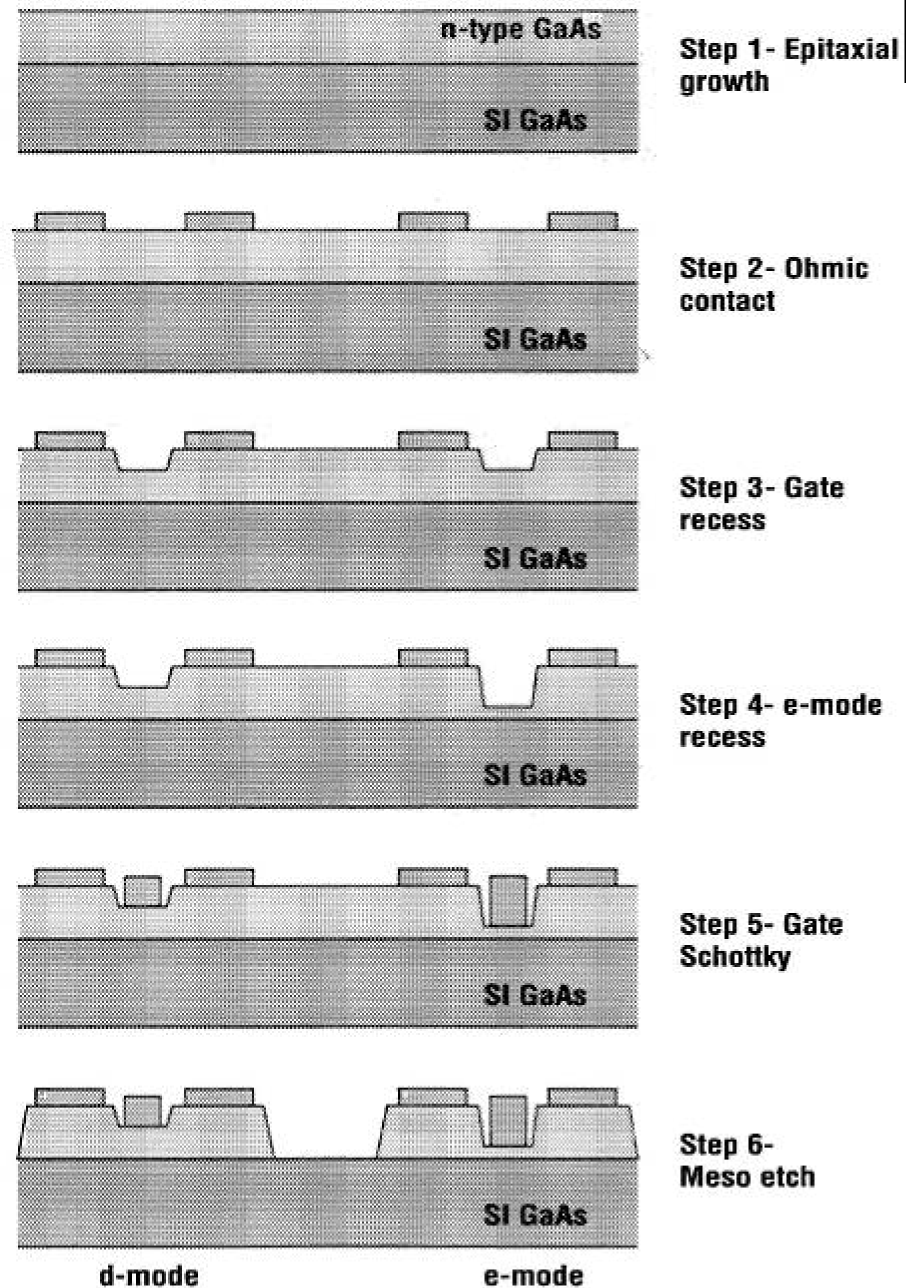


Figure 17.5 Process flow for an etched-channel E/D technology.

A-implantation

SiN deposition

Multilayer resist patterning

n^+ implantation

SiO_2 sputter deposition

Liftoff

Annealing

Ohmic contact metallization

Ohmic alloying

Gate metallization

n-implantated layer

Photoresist

S.I. GaAs

(A)

Multilayer resist

Top photoresist

SiO_2

Bottom resist

PECVD Si_3N_4

(B)

(C)

Second SiO_2

n^+ implanted layer

(D)

Second SiO_2

(E)

Source

Drain

(F)

Gate

(G)

TiW

n-type active layer

SI GaAs substrate

Ni or Al etch mask

TiW

n^+

n^+

Resist

n^+

n^+

AuGeNi/Ag/Au

TiW

n^+

n^+

Gate metal deposition Sputter $Ti_{0.3}W_{0.7}$

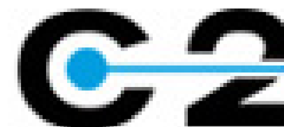
T-gate formation Liftoff each mask, plasma etch of TiW in CF_4

N⁺ Implant Si, 10^{13} cm^{-2}, remove etch mask, anneal

Isolation implant Boron or hydrogen

Ohmic metal Liftoff AuGeNi/Ag/Au Alloy

Figure 17.6 The self-aligned gate process implantation N^+ technology (SAINT) *(after Yamaski et al., ©1982 IEEE)* and the T-gate process. The order of the last two steps of the T-gate may be reversed to reduce any isolation degradation.



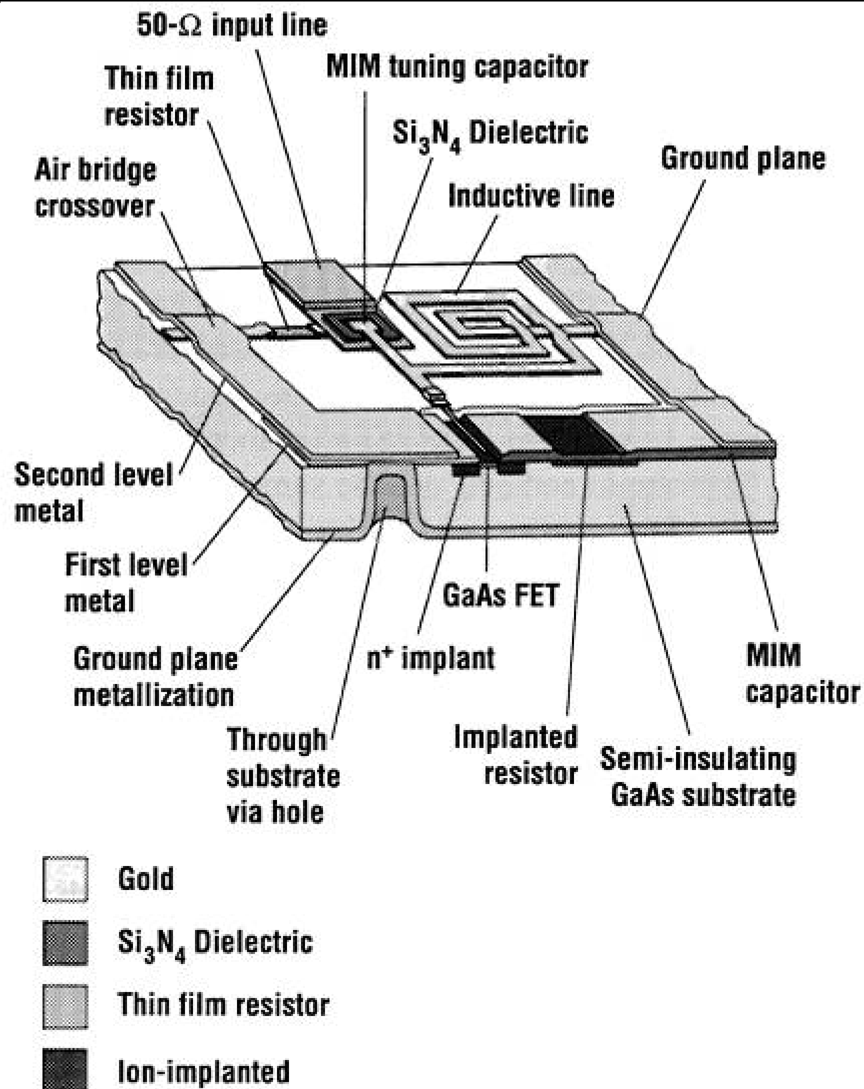


Figure 17.8 Cross-sectional view of a typical MMIC *(after Decker).*

MMIC = Monolithic Microwave Integrated Circuit

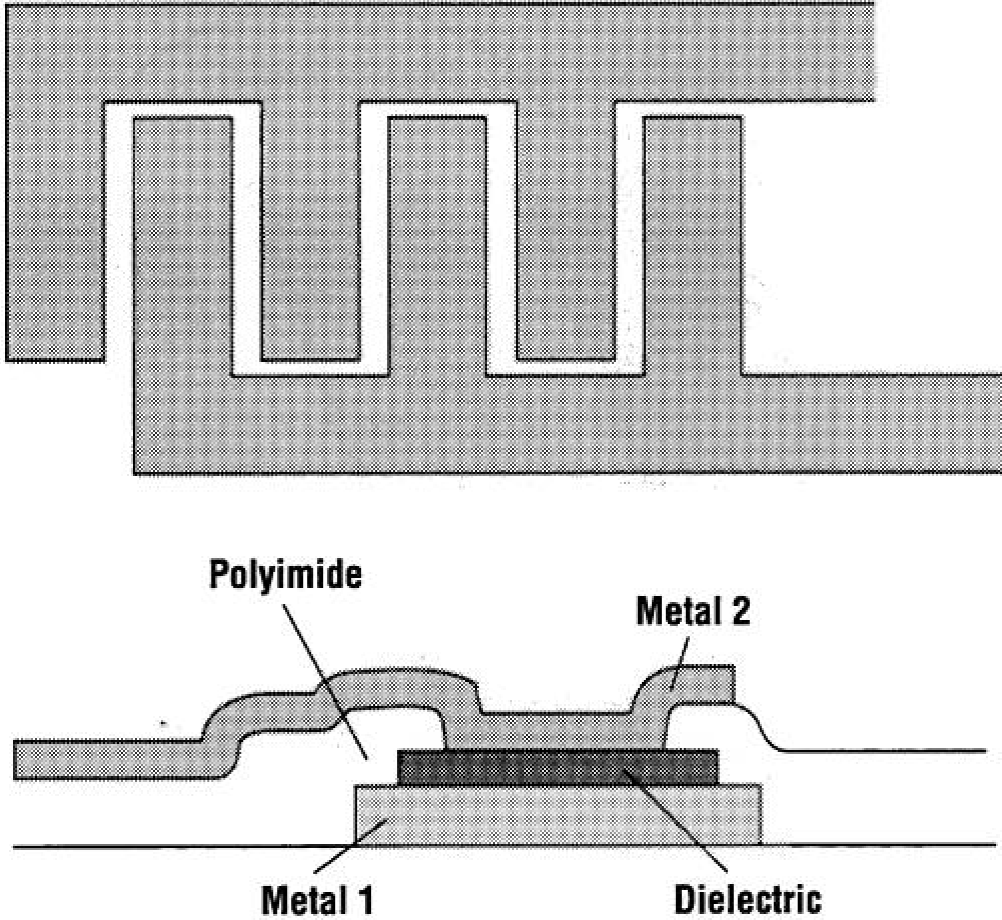


Figure 17.9 Interdigitated and simple overlay capacitor.

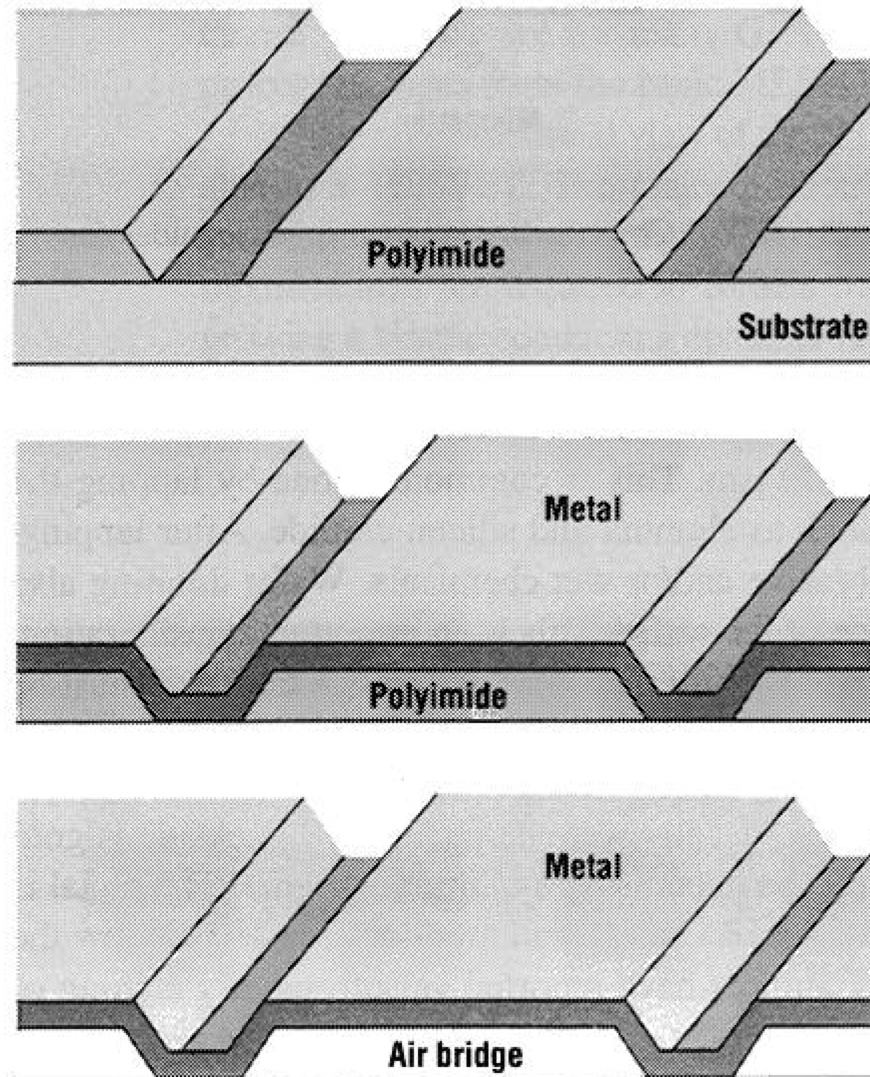


Figure 17.10 Air bridge process flow.

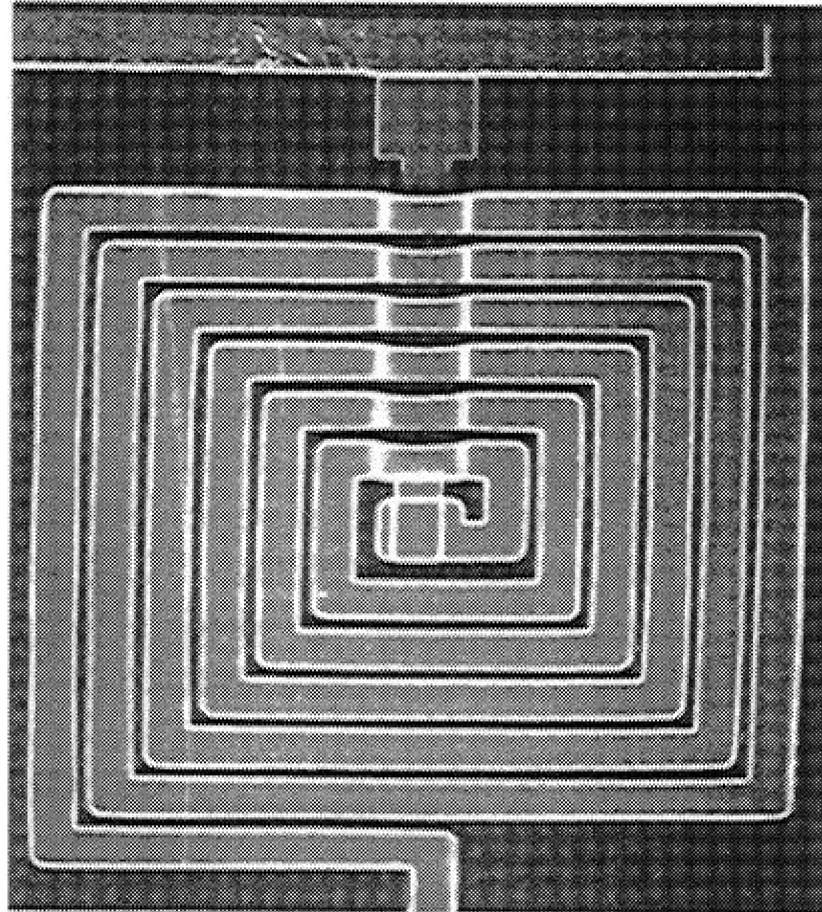


Figure 17.11 Completed spiral inductor using an air bridge crossover *(after Sciater, reprinted by permission, TAB Books. Inc.).*

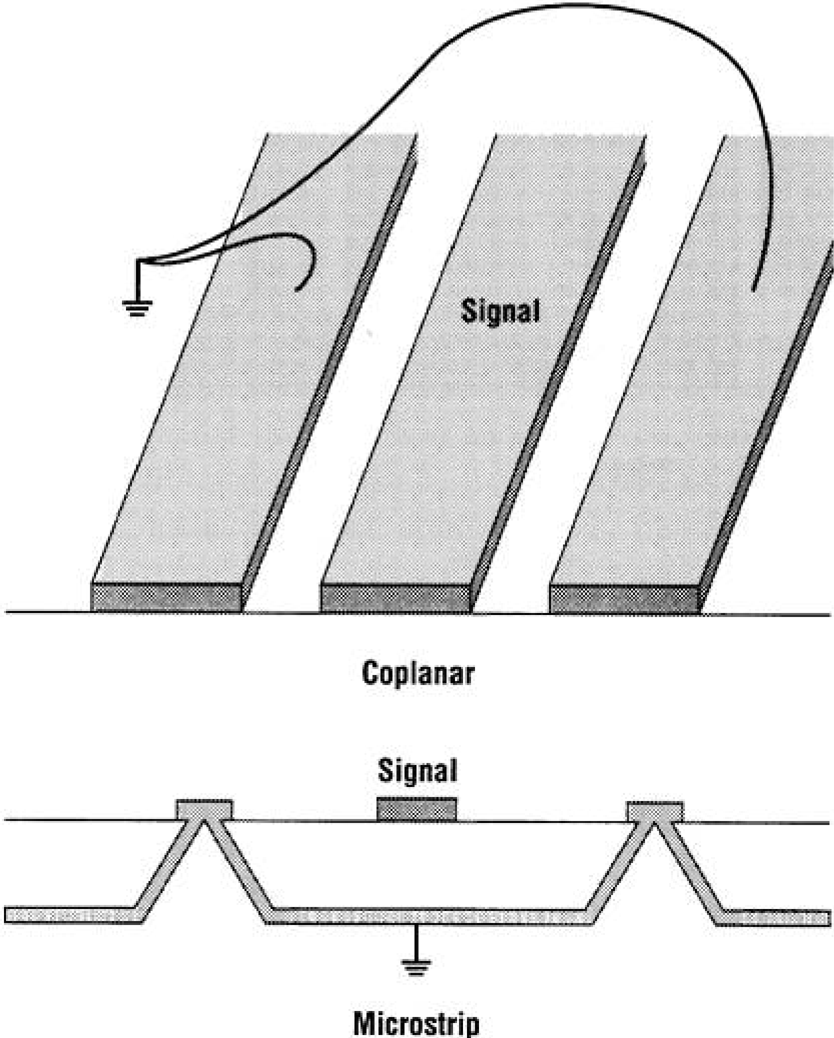


Figure 17.12 Coplanar and microstrip waveguides for MMIC interconnect.

Lots of interest in recent years for InP-based devices

=> Better performance at very high frequencys (> 100 GHz)

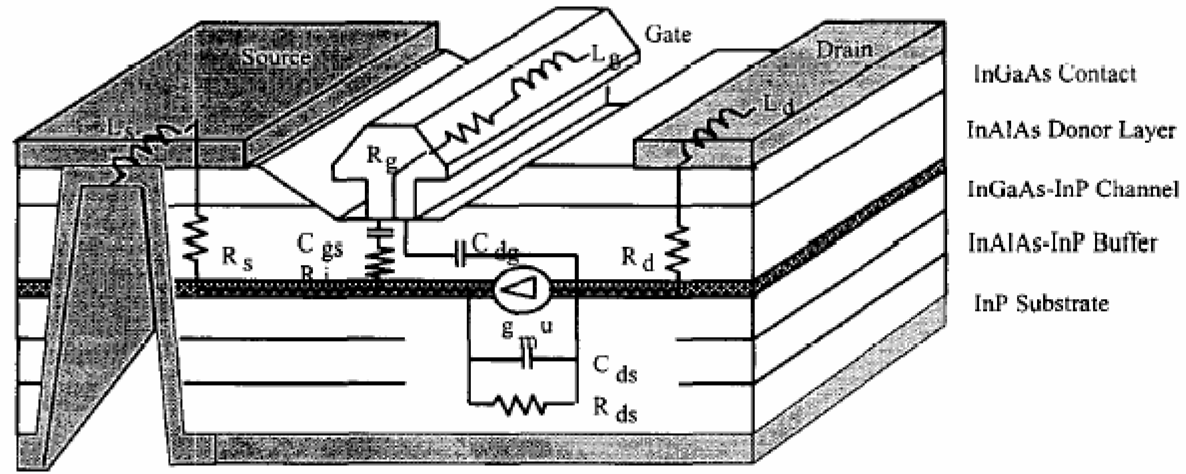


Fig. 1. Baseline pseudomorphic InP HEMT device profile.

MC2

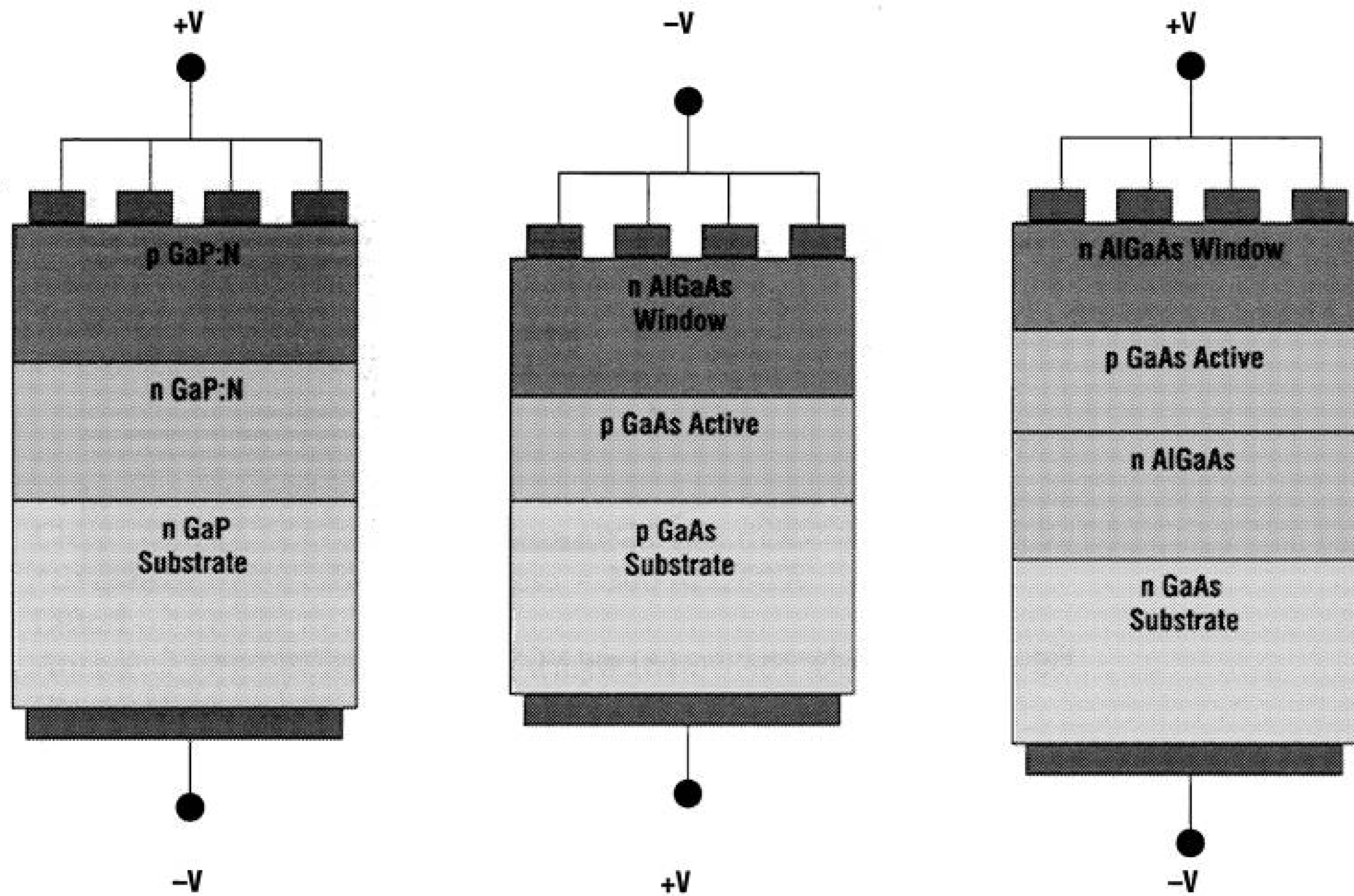


Figure 17.14 Typical homojunction (A), single barrier (B), and double barrier (C) LED structures. If backside contact is not desired, the stack can be etched down to the substrate and a top side substrate contact added.