Heterostructures

Heterojunction:

e.g. between GaAs (W_g~1.4 eV) and AlGaAs (W_g~1.6-1.9 eV)

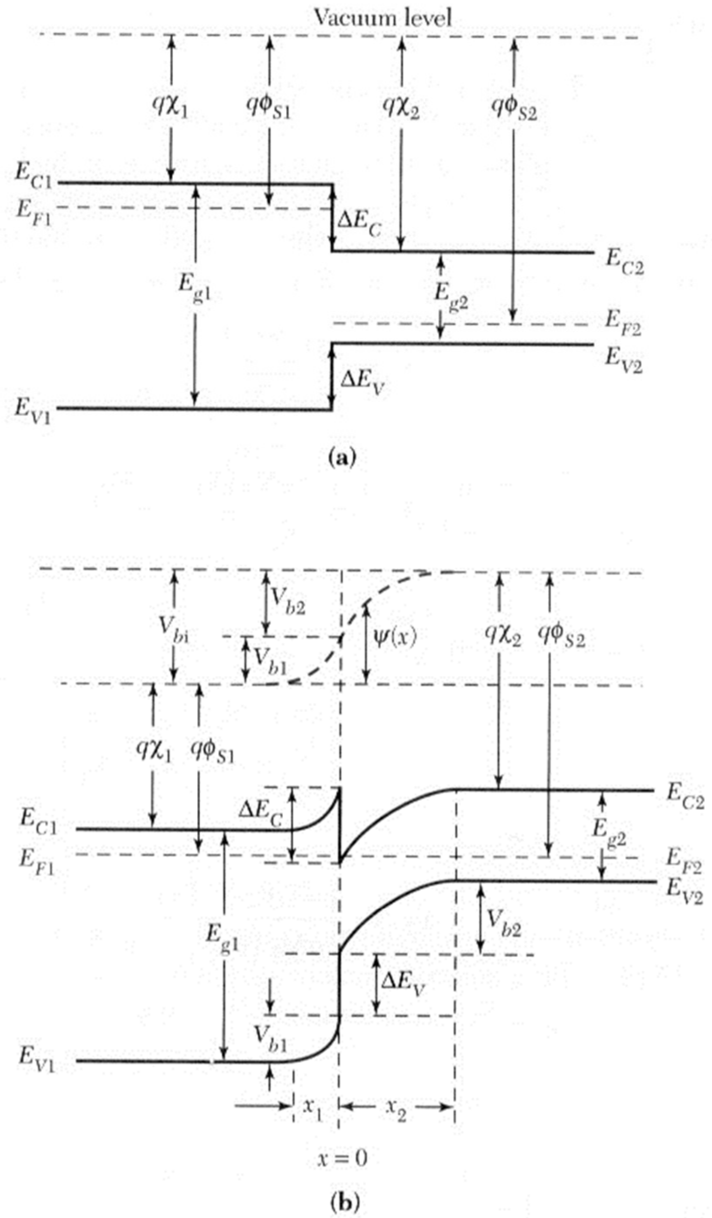


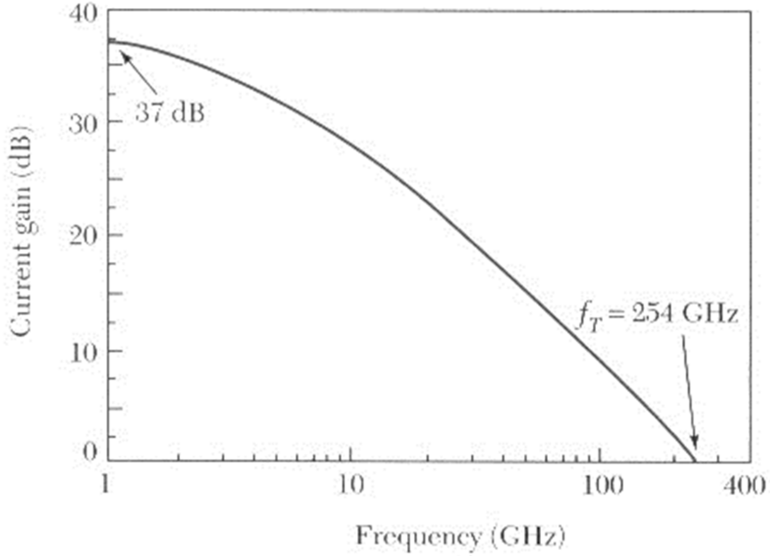
Fig. 32 (*a*) Energy band diagram of two isolated semiconductors. (*b*) Energy band diagram of an ideal *n–p* heterojunction at thermal equilibrium.

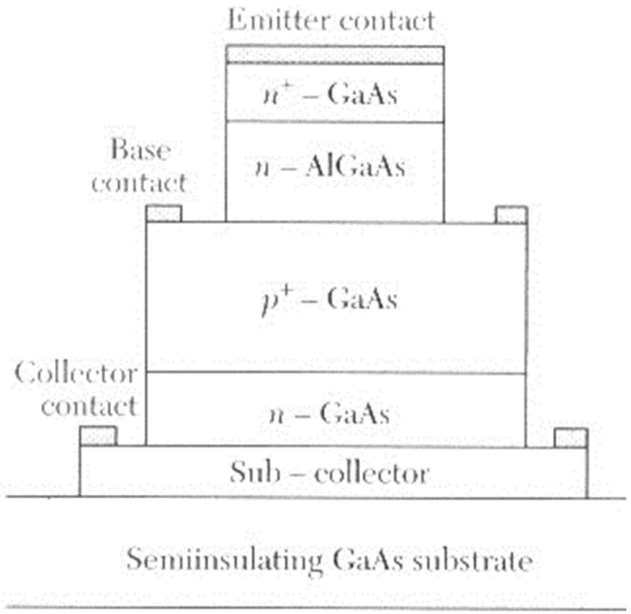
HBT

- Heterojunction bipolar tr:

- very fast (highly doped base!)

- e.g. with AlGaAs and GaAs





HBT

- …or with SiGe

- more current
- faster
- higher V_A

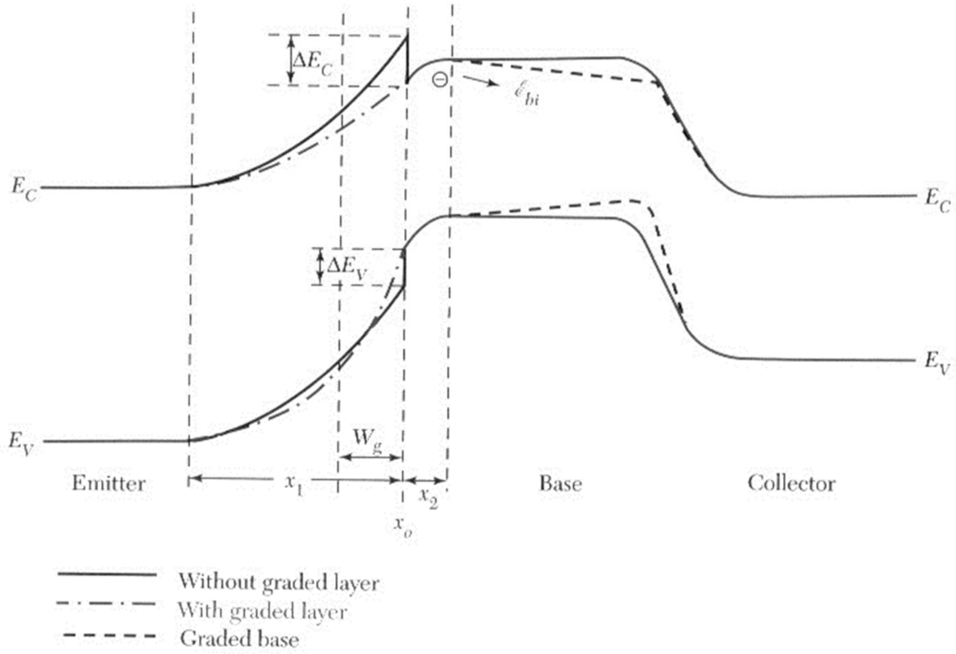
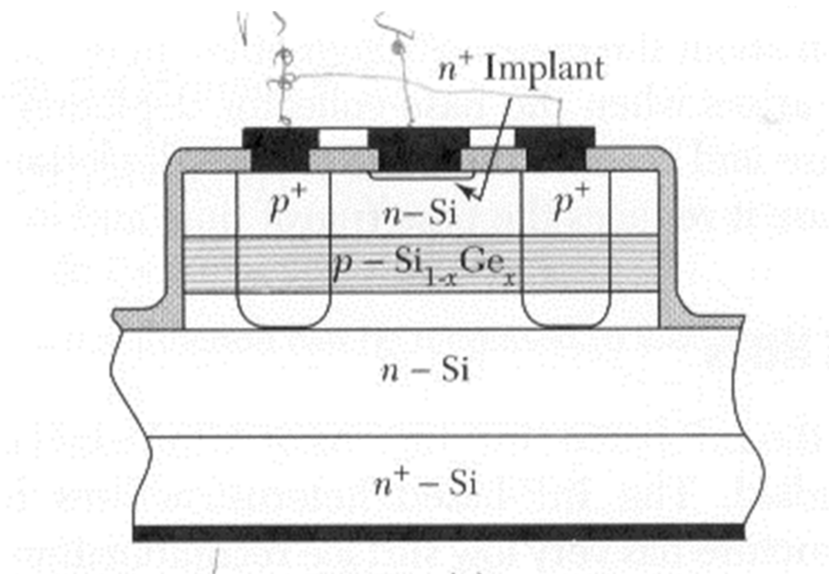


Fig. 20 Energy band diagrams for a heterojunction bipolar transistor with and without graded layer in the junction, and with and without a graded-base layer.



(a)

HEMT

- High electron mobility tr. (HEMT, or MODFET): fast (electrons don't move close to the surface, and are in a undoped region)

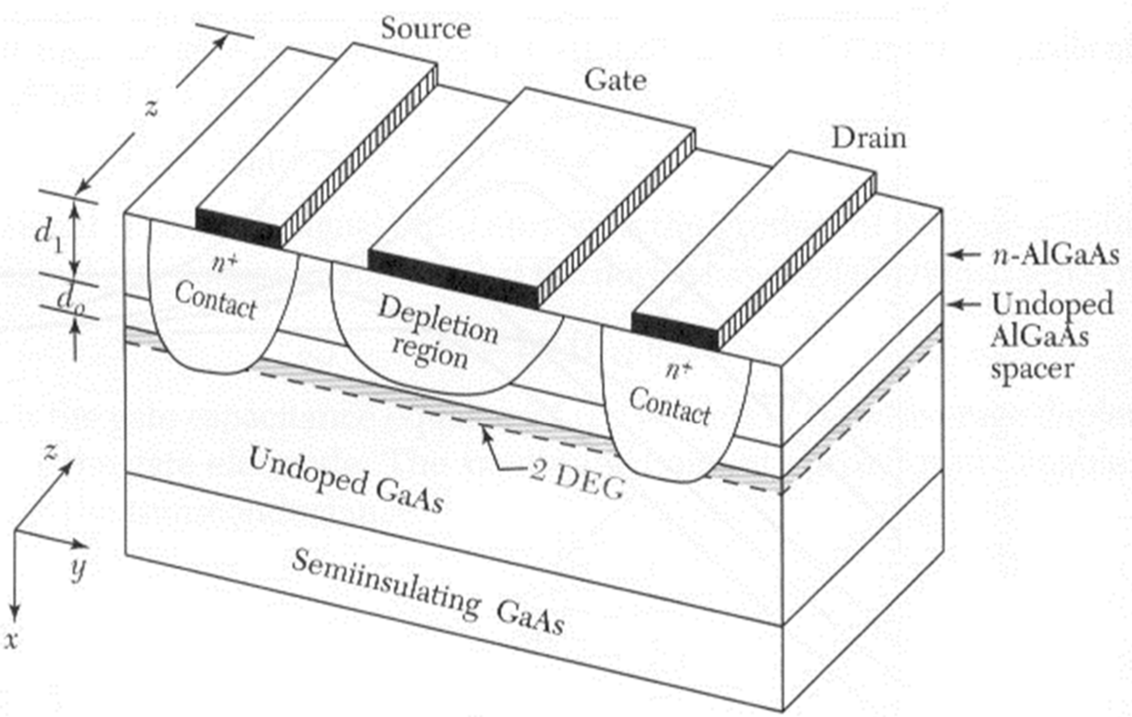


Fig. 16 Perspective view of a conventional modulation-doped field-effect transistor (MODFET) structure.

- FET: performance comparison:

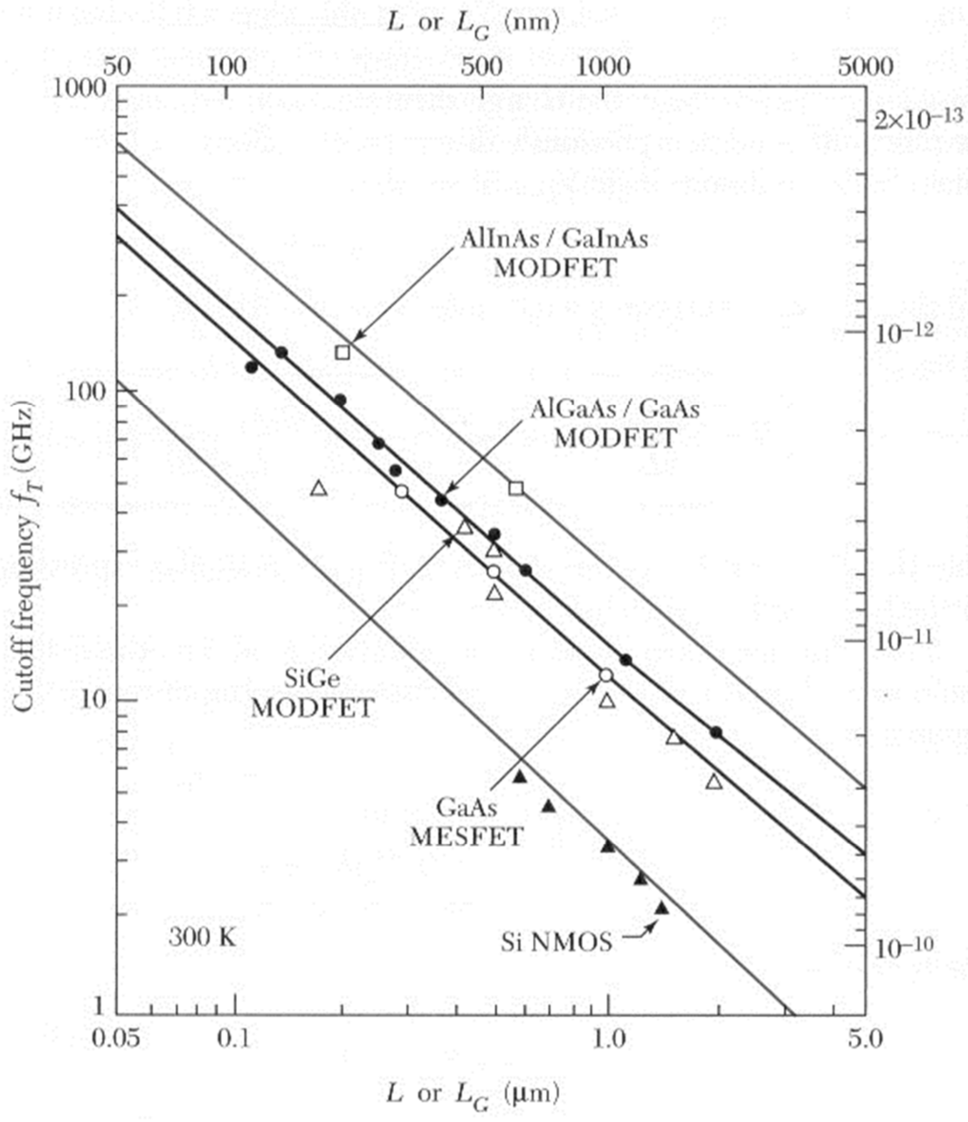
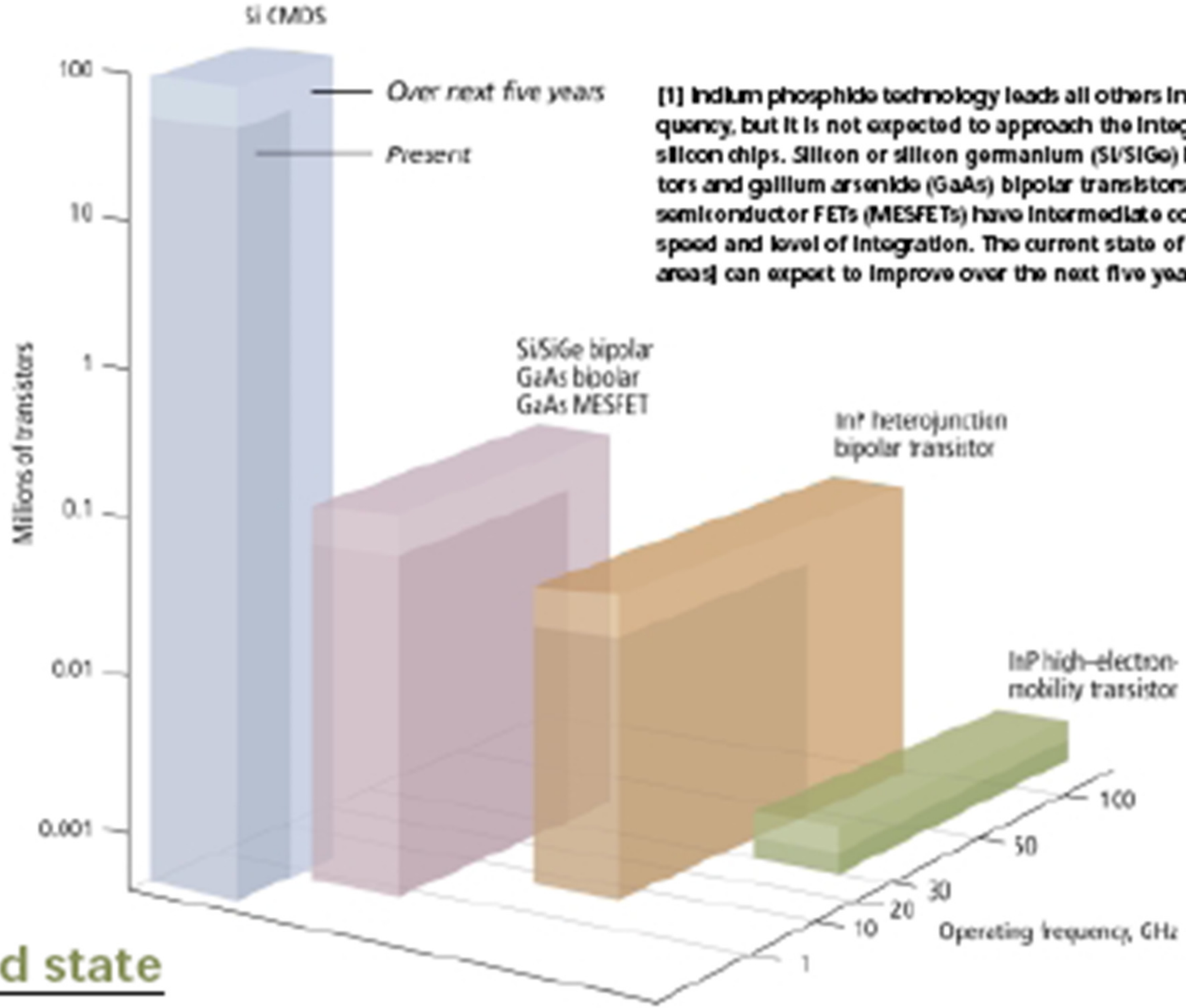
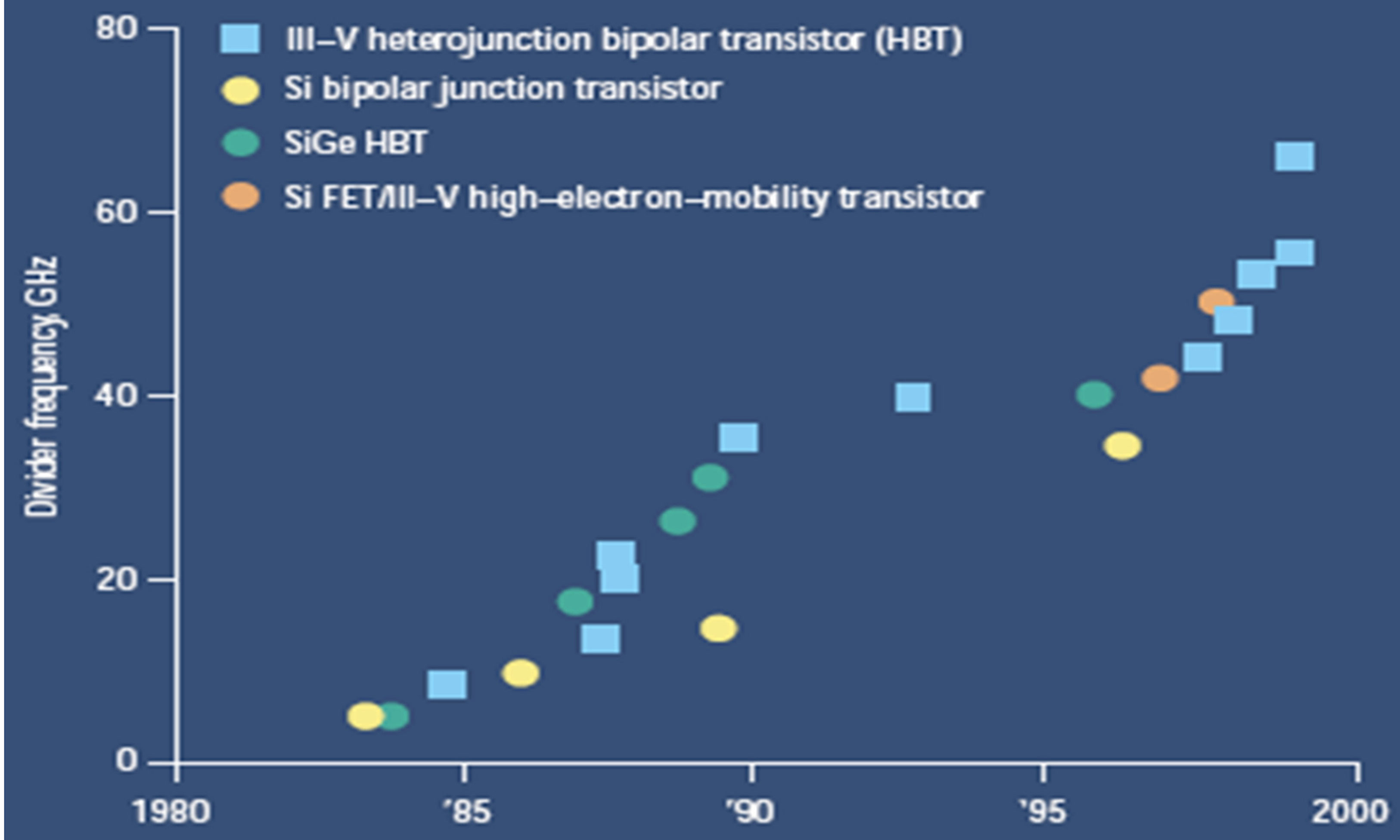


Fig. 18 Cutoff frequency versus channel or gate length for five different field-effect transistors.[8,10]



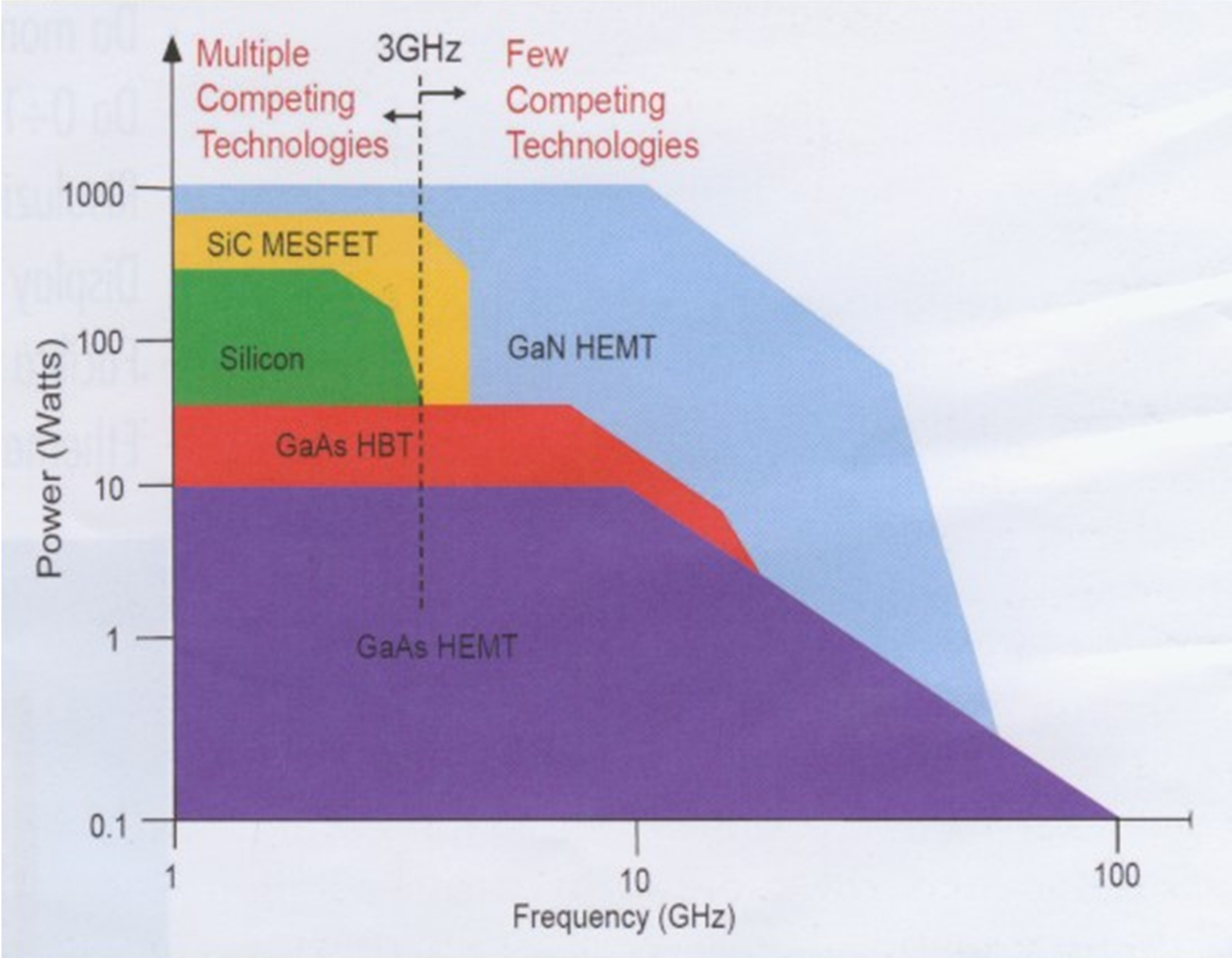
[1] Indium phosphide technology leads all others in operating frequency, but it is not expected to approach the integration scale of silicon chips. Silicon or silicon germanium (Si/SiGe) bipolar transistors and gallium arsenide (GaAs) bipolar transistors and metal semiconductor FETs (MESFETs) have intermediate combinations of speed and level of integration. The current state of the art [dark areas] can expect to improve over the next five years [light areas].

solid state



[6] Historically, heterojunction bipolar transistors (HBTs) made using indium phosphide or other III-V materials yielded the fastest static dividers.

[2015]



Multiple
Competing
Technologies
3GHz
Few
Competing
Technologies
1000
100
10
1
0.1
Power (Watts)
SiC MESFET
Silicon
GaN HEMT
GaAs HBT
GaAs HEMT
1
10
100
Frequency (GHz)