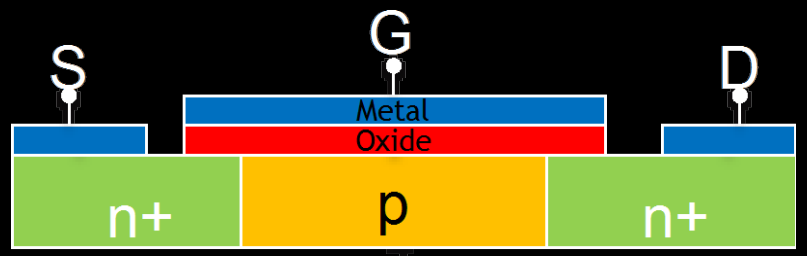
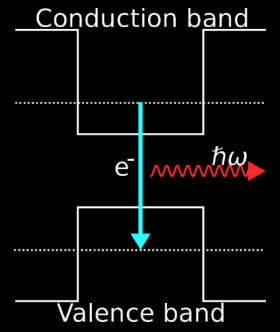
Solid State Devices
Section 1: Introductions

Section 1.2

Basic Device Operations
Raising 1,000 Questions





Gerhard Klimeck
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Basic Device Operations
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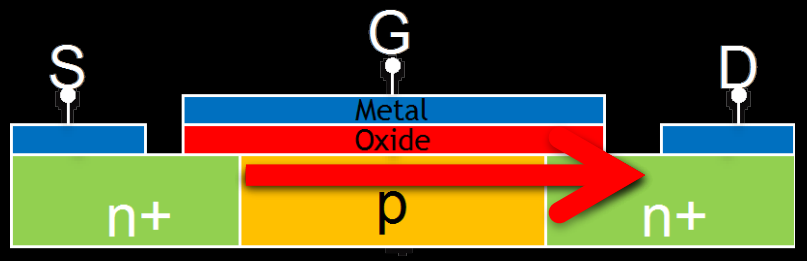
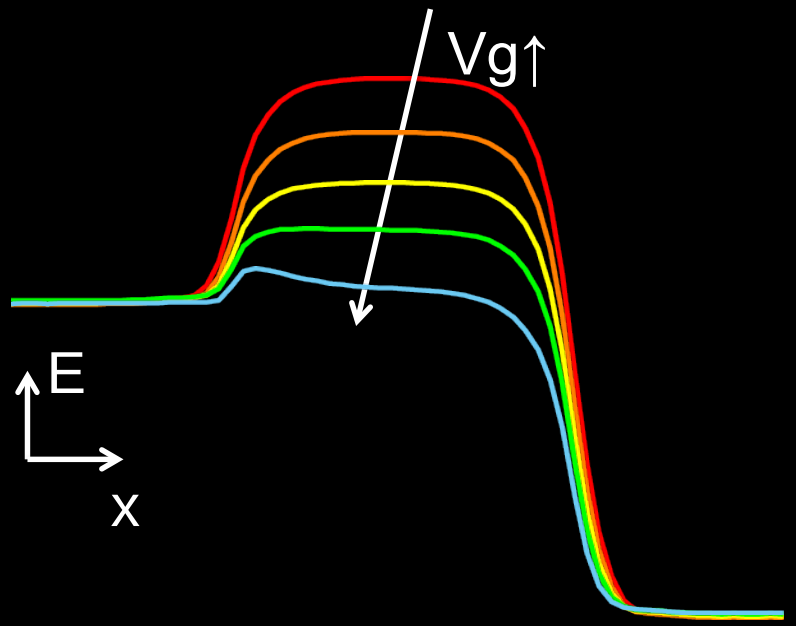
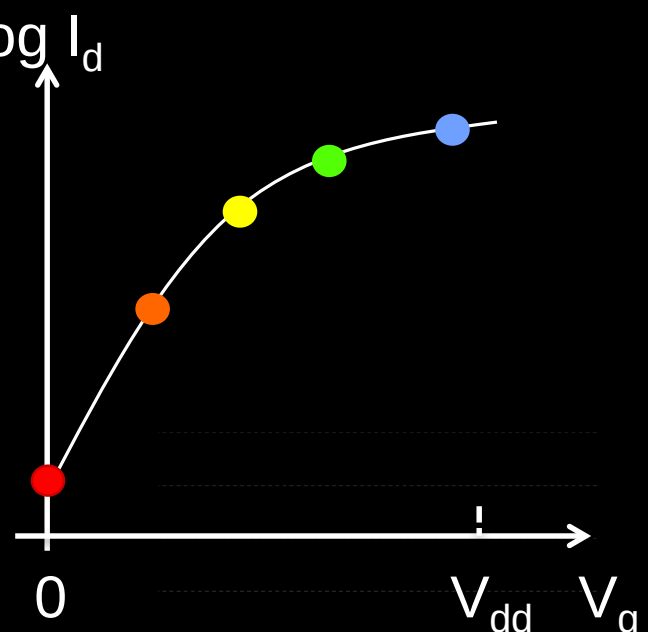
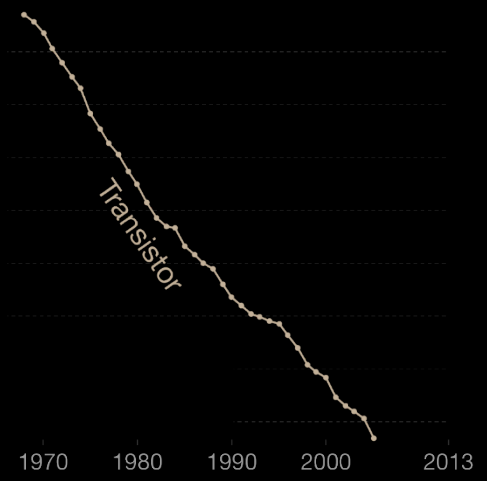


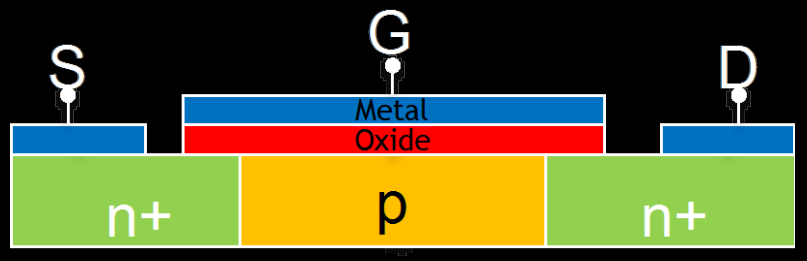


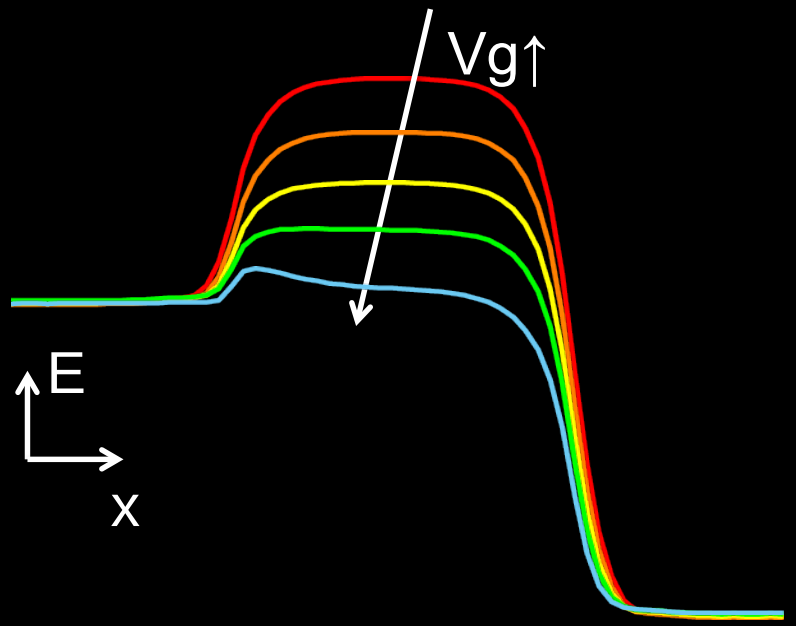


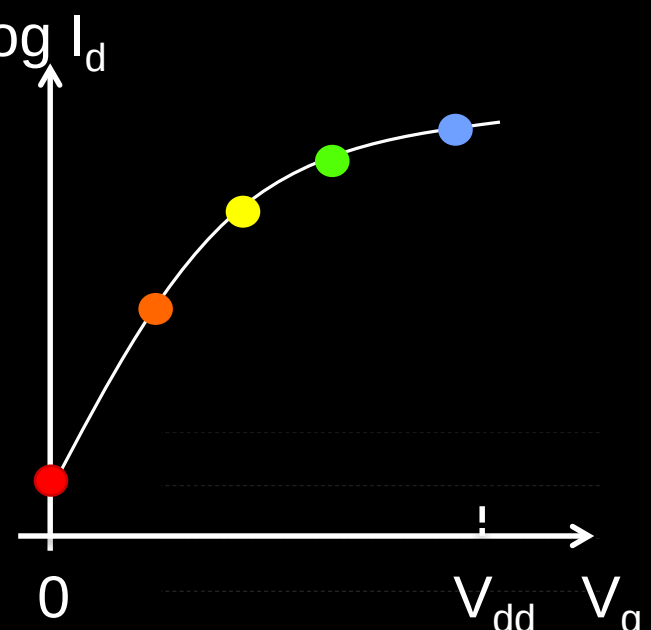


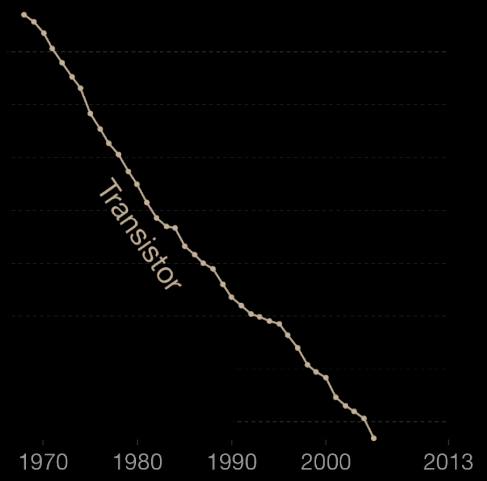
- Explain the working principles of these devices
- Explain the physical processes in these devices

Fundamental Transistor Operation









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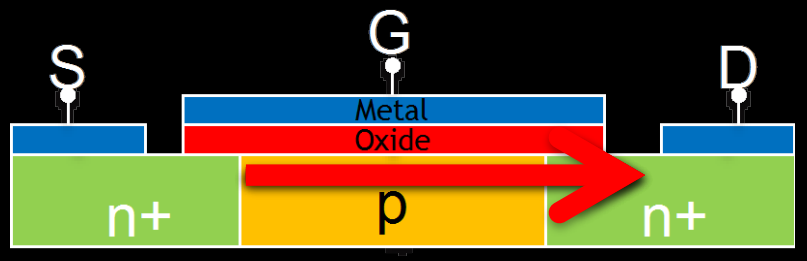

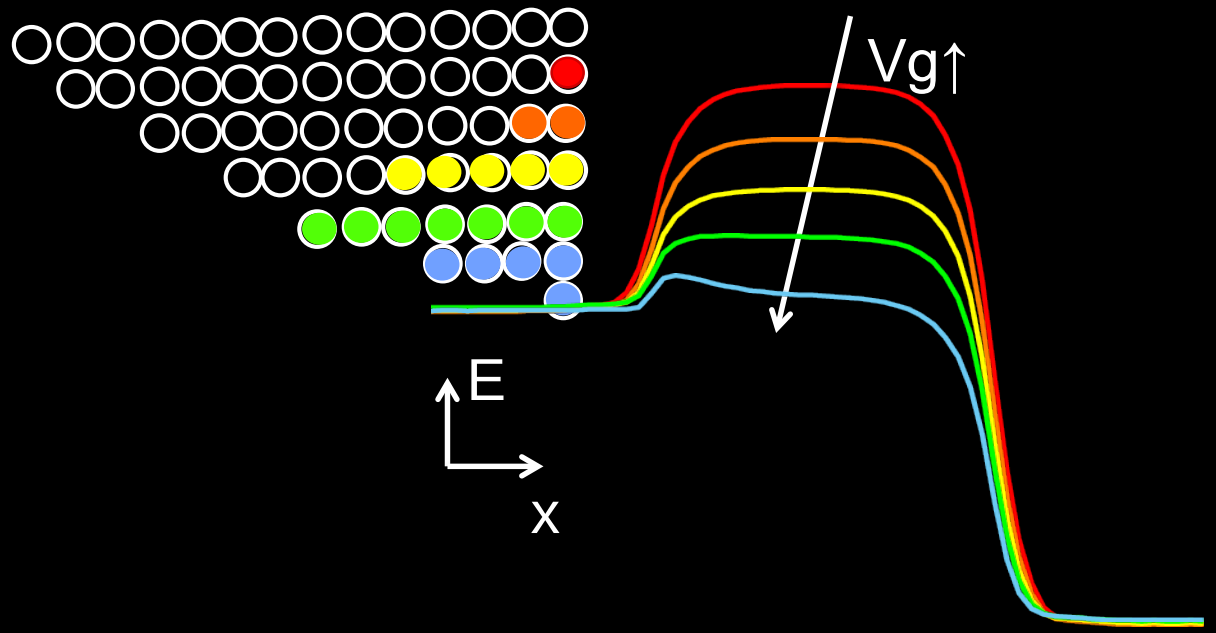

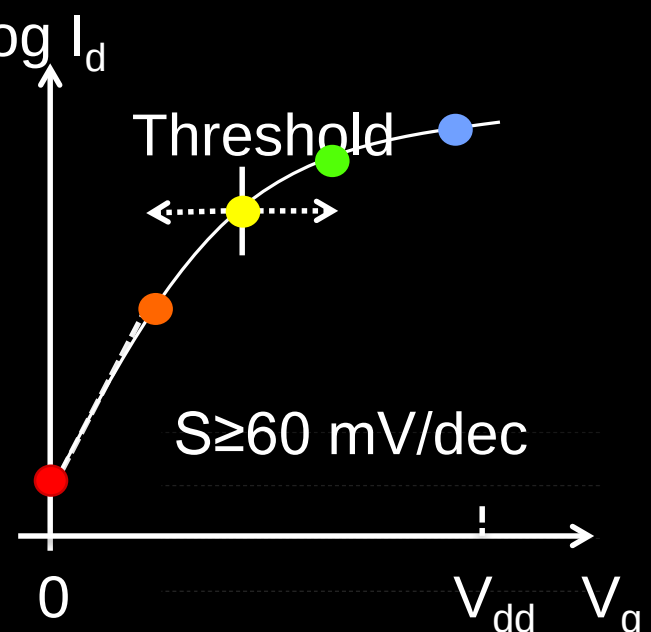

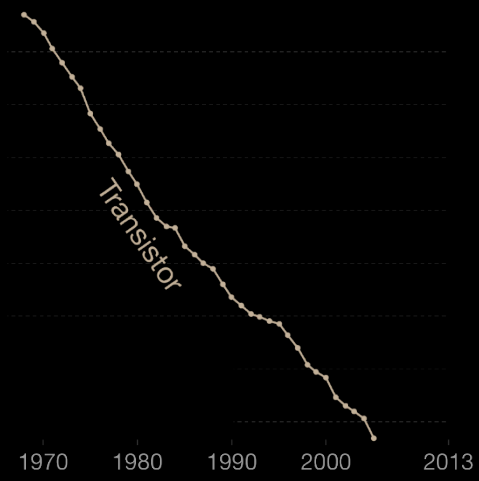

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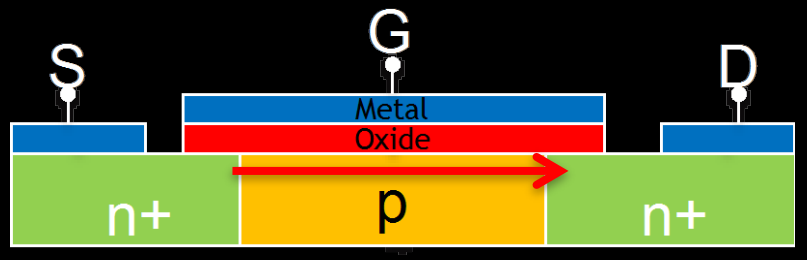
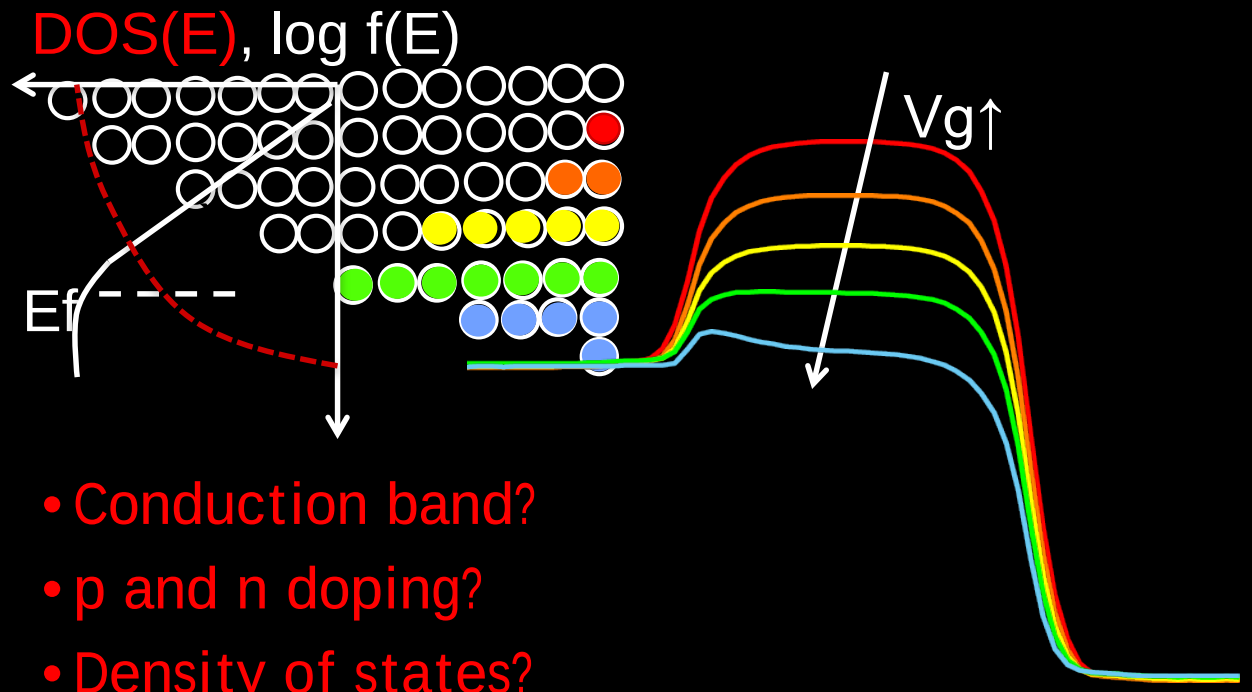
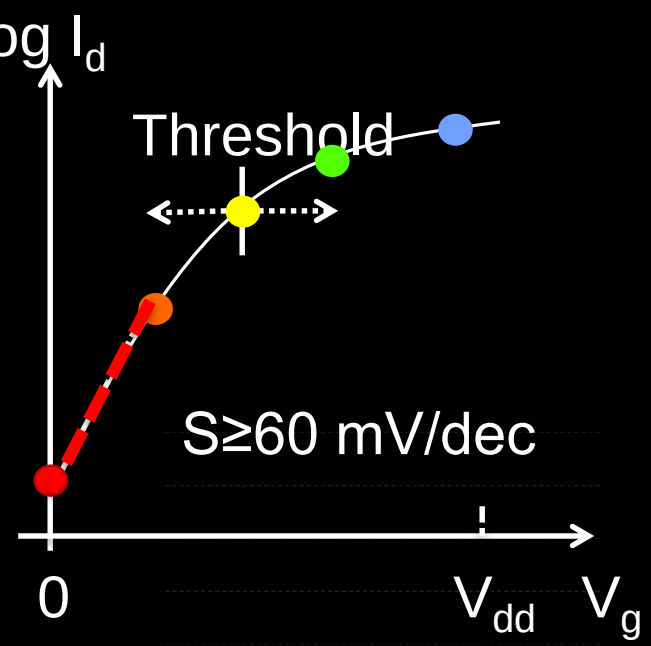
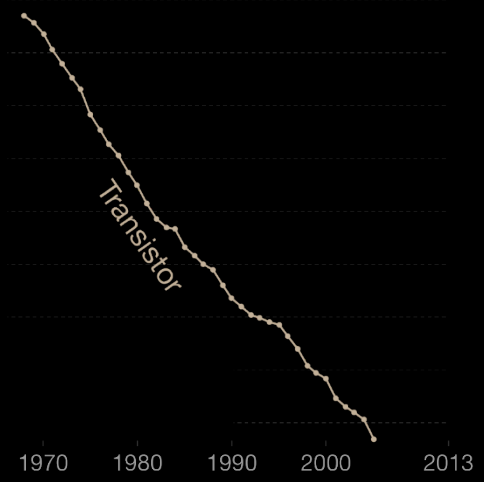
A Picture speaks a 1000 words – but:
These pictures should inspire a 1000 questions!



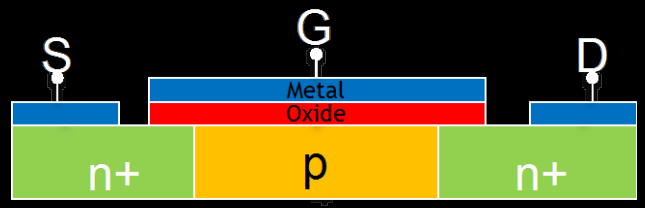


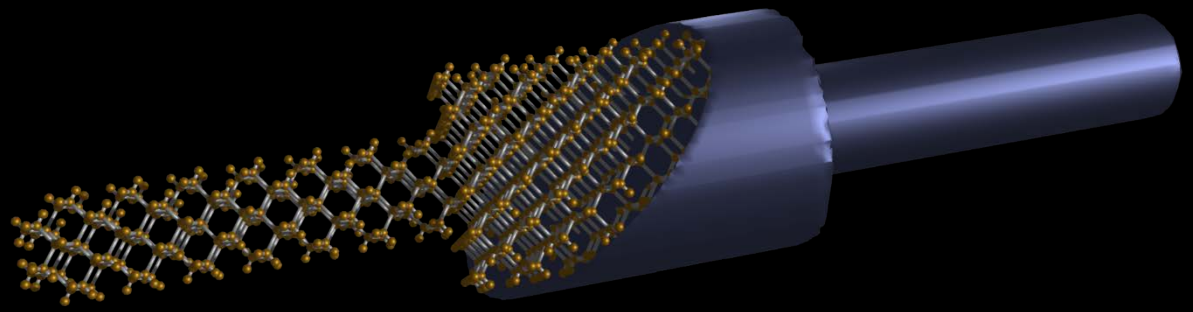


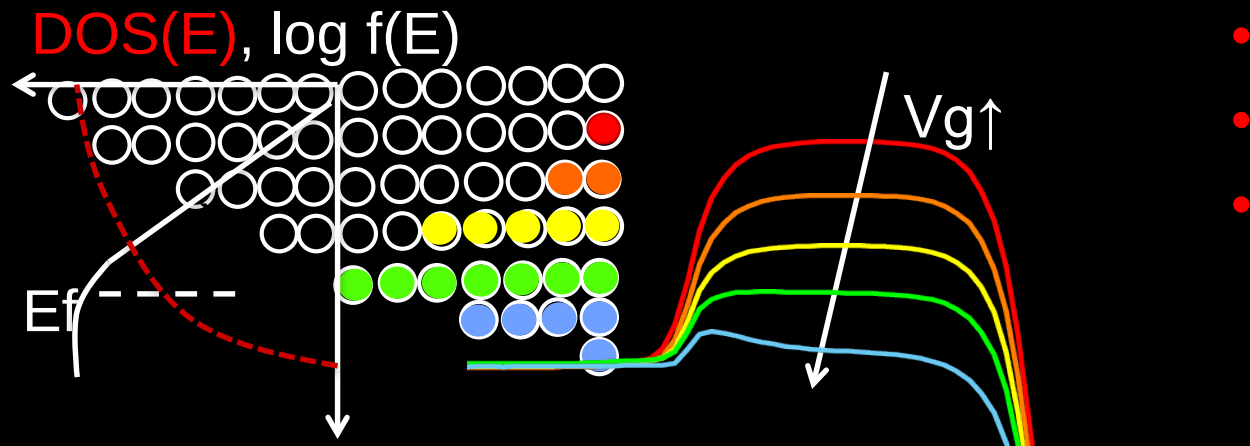
- Conduction band?
- p and n doping?
- Density of states?
- Fermi distribution?
- 60mV/dec?



Modern Devices are not planar – but 3D
These pictures should inspire a 1000 questions!

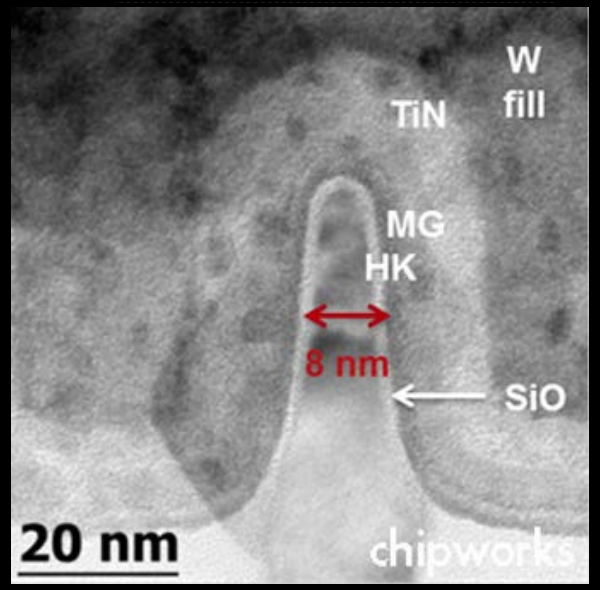






- Conduction band?
- p and n doping?
- Density of states?
- Fermi distribution?
- 60mV/dec?

- Material choices
- Crystal structures
- Structure / Geometry



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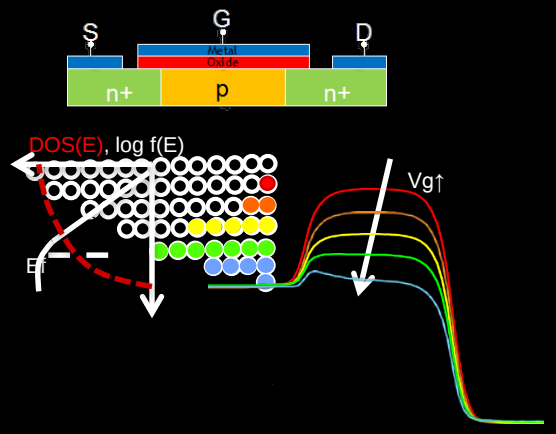
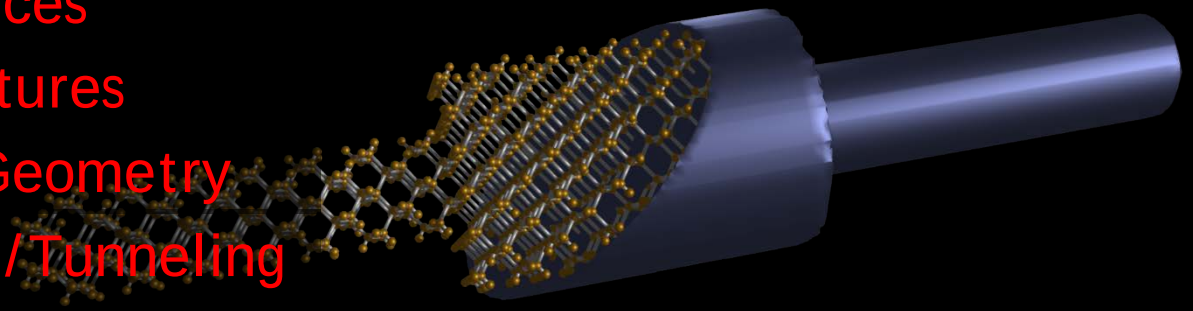
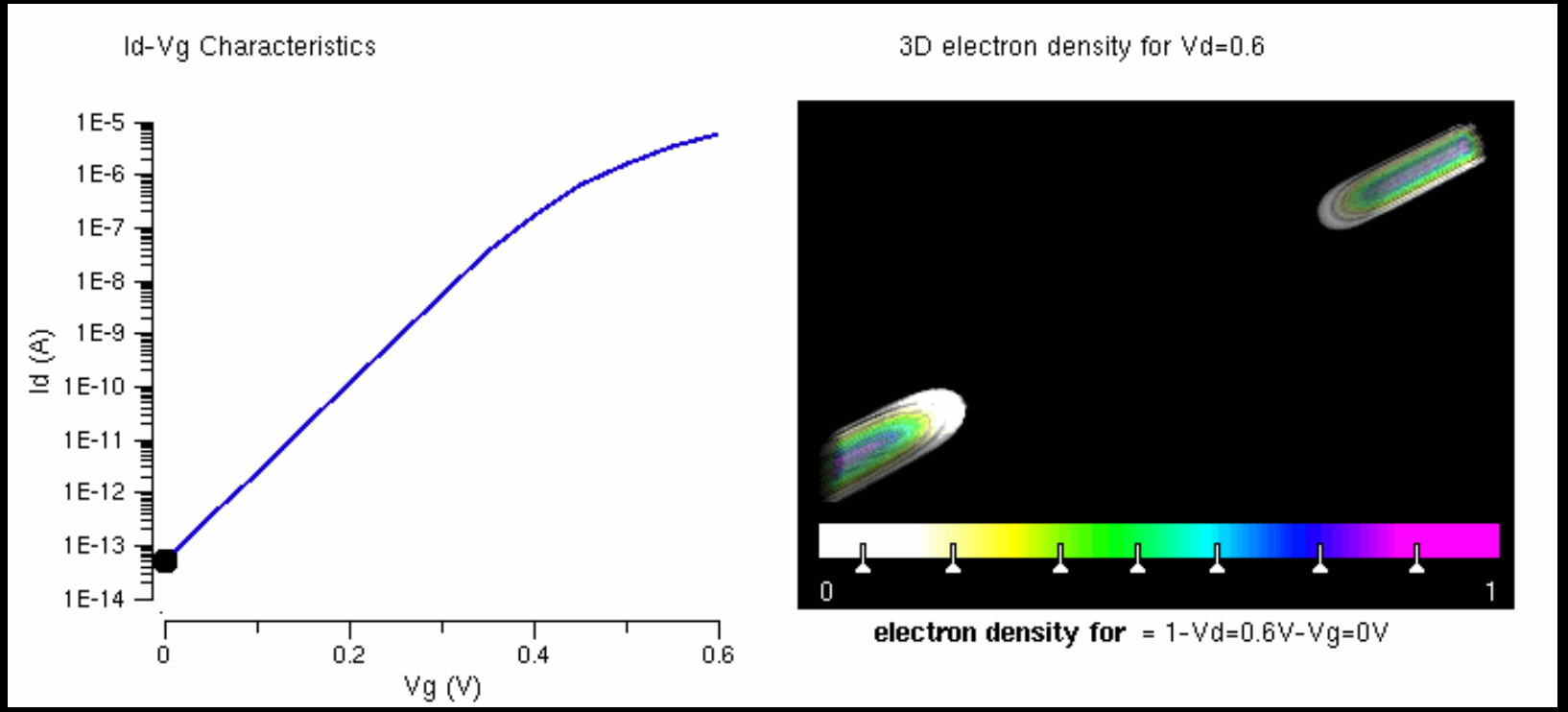
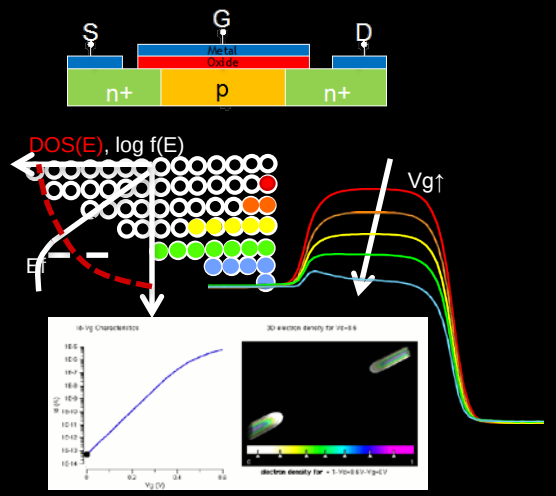


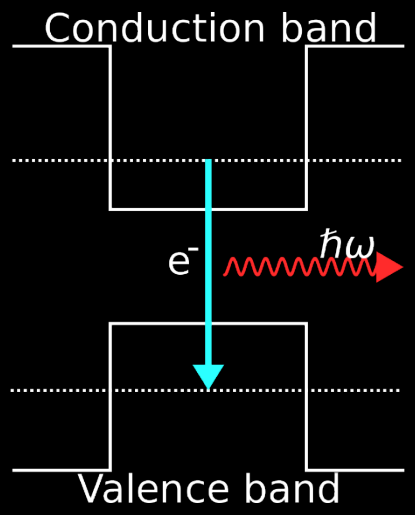
- Material choices
- Crystal structures
- Structure / Geometry
- Confinement / Tunneling
- Strain





Beyond the Transistor
Optical Interactions





- Valence band?
- Light emission/absorption
- e-e and e-ph interactions

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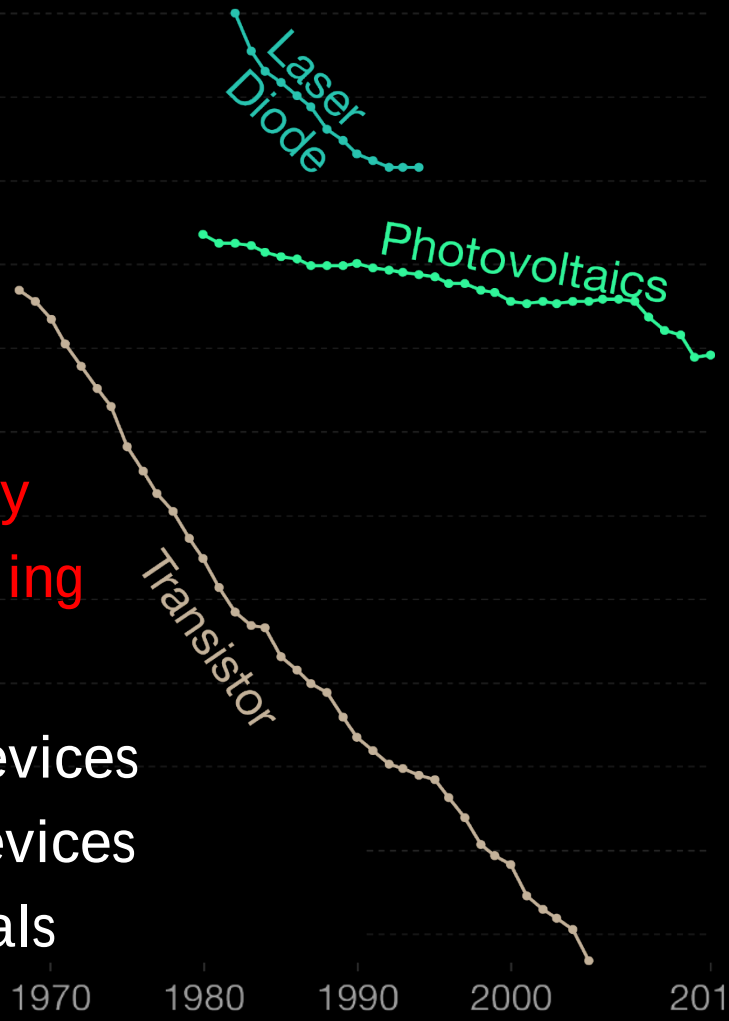
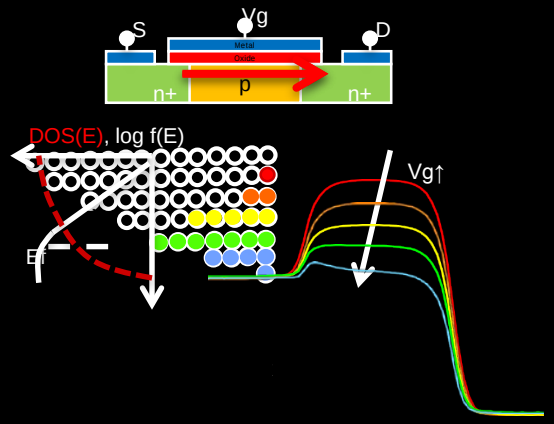
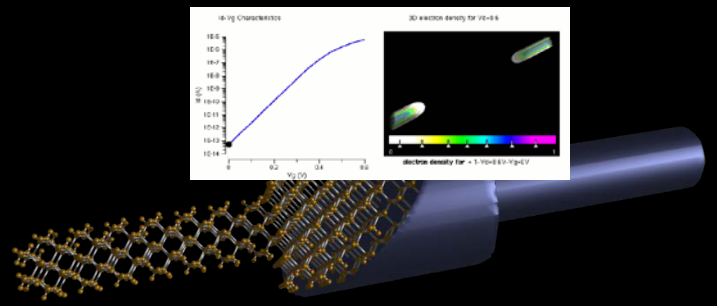
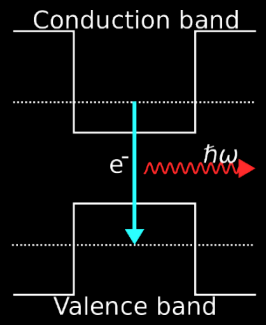


- Explain the working principles of these devices
- Explain the physical processes in these devices
- Relate the device performance to materials and design criteria

Solid State Devices
Learning Outcomes







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- Be ready to engage in device research

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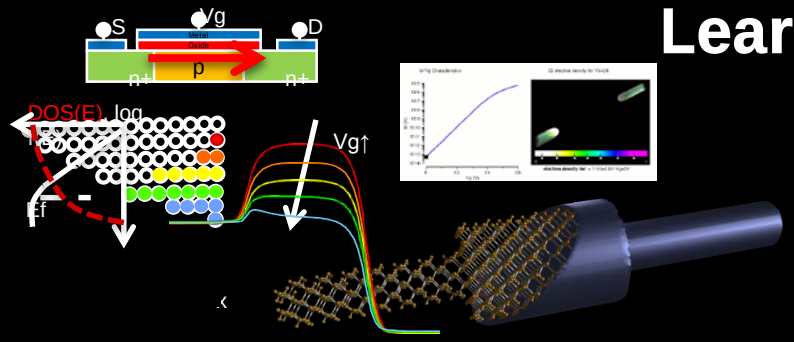

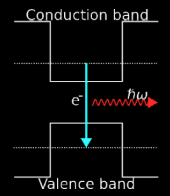

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- Foundations of typical job interview
  - »How to “think” about electrons in a semiconductor
  - »Technical interviews will typically not go into more detail
  - »Probe the understanding of electronics in semiconductors

=> Your entry into a technical job in Semiconductor Industry

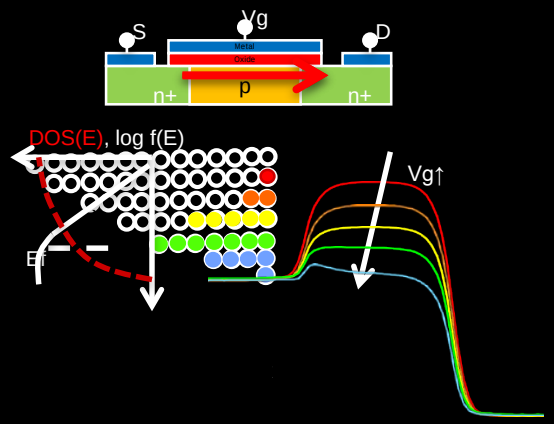
- MN PhD Qualifier => Your entry into the PhD program in the MN area

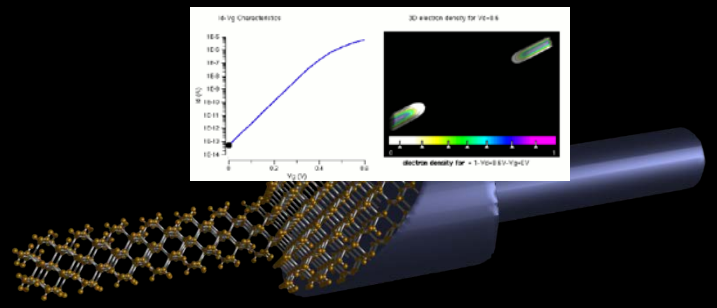
Solid State Devices

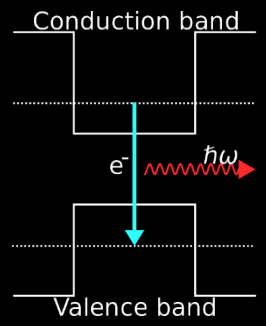
Section 1.1

Section 1.2

Why are they interesting?
Learning Outcomes
Basic Device Operations
Raising 1,000 Questions







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Solid State Devices

Section 1.1

Section 1.2

Section 1.3

Why are they interesting?
Learning Outcomes
Basic Device Operations
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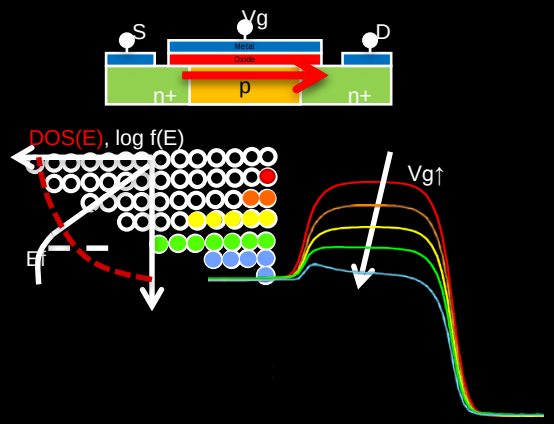
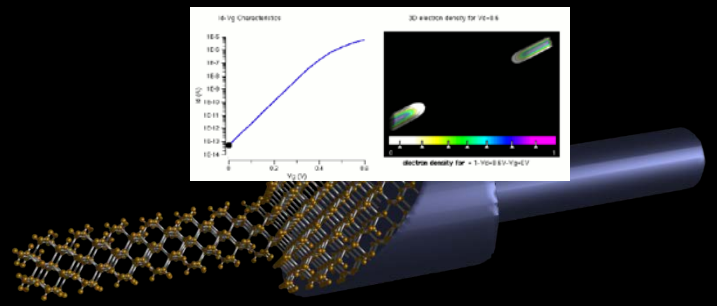
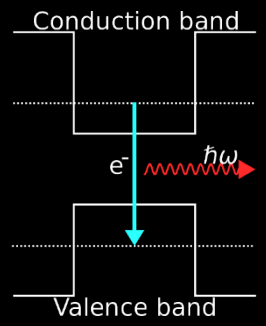
Course Content Requirements







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