Section 1 – Introductions
1.3 Course Content and Requirements

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PURDUE UNIVERSITY

School of Electrical and Computer Engineering

Section 1
Introductions

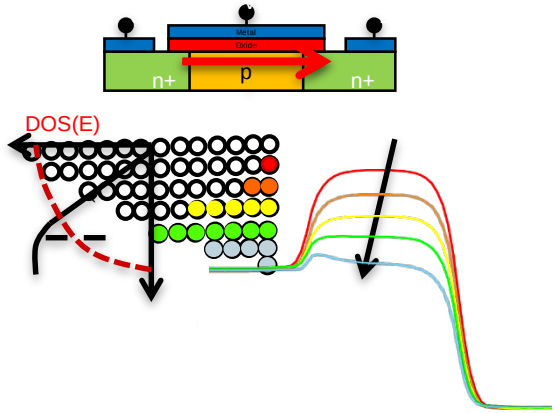
One Video Segment

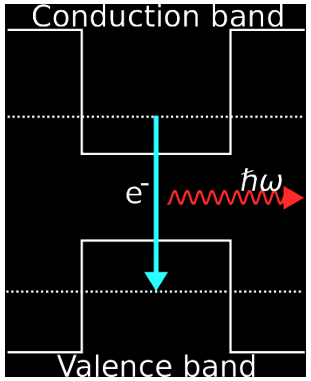
- 1.1 Solid State Devices
  - » Why are they interesting
  - » Learning Outcomes

- Explain the working principles of these devices
- Explain the physical processes in these devices
- Relate the device performance to materials and design criteria
- Speak the "language" of device engineers
- Be ready to engage in device research

One Video Segment

- 1.2 Basic Device Operations – Raising 1,000 Questions





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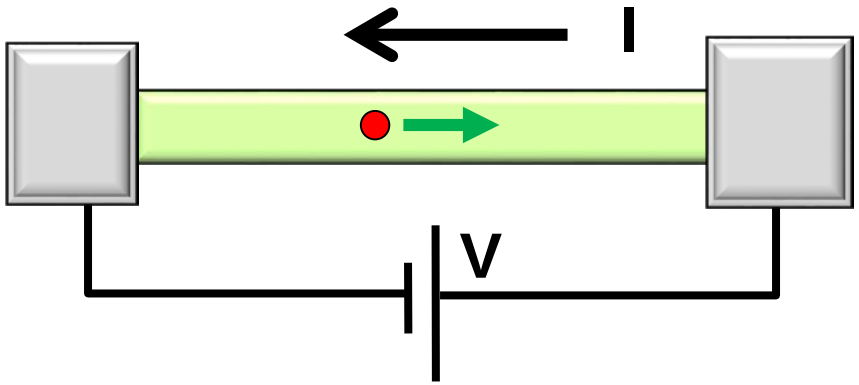
Current Flow Through Semiconductors



$$I = G \times V$$
$$= q \times n \times v \times A$$

charge density velocity area

Section 1.3
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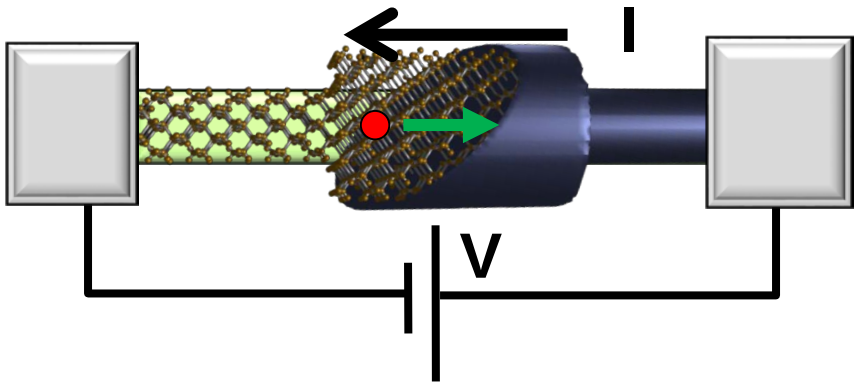

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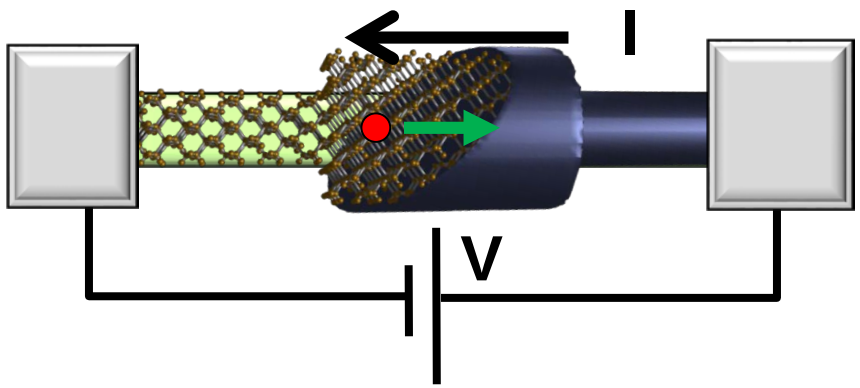

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charge density, velocity, area

- **Materials, composition, crystals**
- Tabulated for "known" bulk materials
- At nm-scale properties change with geometry => theory

⇒ **Quantum Mechanics + Equilibrium Statistical Mechanics**

- Concepts of effective masses and occupation factors

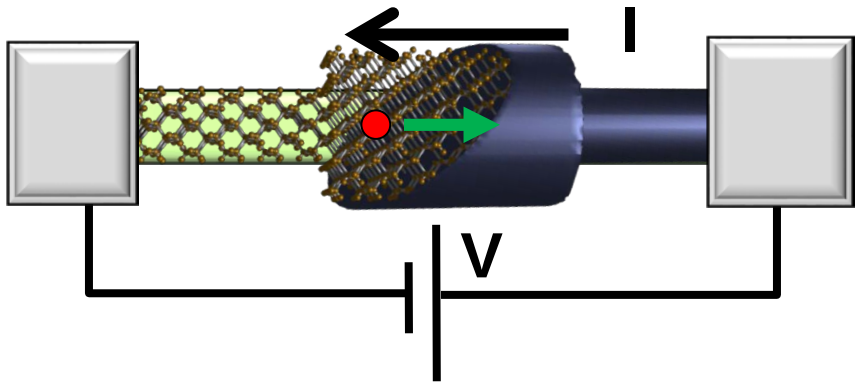
Transport with scattering, non-equilibrium Statistical Mechanics

- Drift-diffusion equation with recombination-generation

Understanding transport in concrete devices

- Diodes, BJT/HBT, MOS

Course Structure



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charge density velocity area

- **Materials, composition, crystals**

⇒ **Quantum Mechanics + Equilibrium Statistical Mechanics**

Transport with scattering, non-equilibrium Statistical Mechanics

5 weeks
1 exam

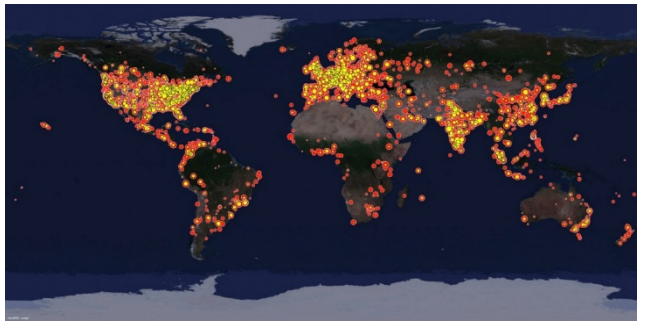
Understanding transport in concrete devices
- Diodes, BJT/HBT, MOS

3+3+3 weeks
2 exams

Your Content Contributors and Instructor

- Prof. Muhammad Ashraful Alam
  - » Created the first sequence of the course slides
  - » 2009 version of the course at nanoHUB https://nanohub.org/resources/5749

- Dr. Parijat Sengupta
  - » Intel Corporation
  - » Helped with assignments

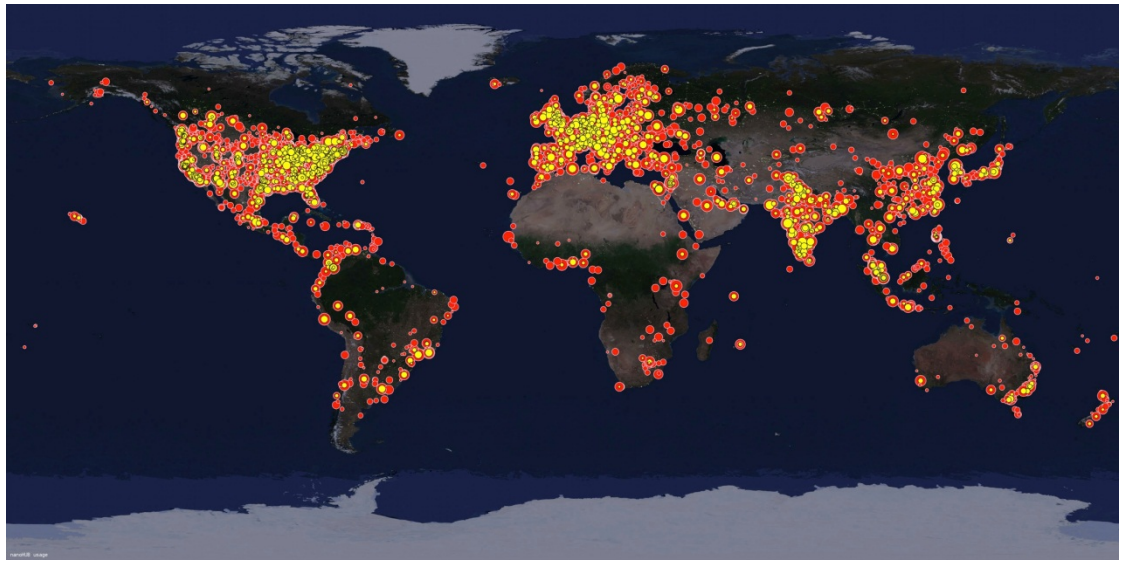


- Gerhard Klimeck
  - » Prof. at Purdue since Dec. 2003
  - » Principal at NASA/JPL, 6 years
  - » Texas Instruments, 4 years
  - » Purdue Graduate (1994)
  - » Over 500 papers on devices/physics
  - » 2012 version of the course at nanoHUB https://nanohub.org/resources/15070

Your Purdue Resources

Klimeck

- Leads the Network for Computational Nanotechnology (NCN)
- NCN hosts nanoHUB.org
- >1.6 million users
- 172 countries
- ~15 professional staff



>6,000 resources on line

Also THIS WHOLE course

https://nanohub.org/resources/15070

Or search for
"Klimeck nanohub 606"

Next Section 1.4 Additional Course Information

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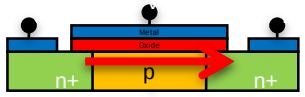

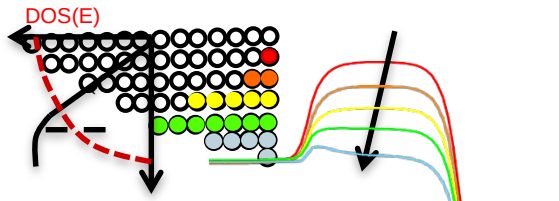

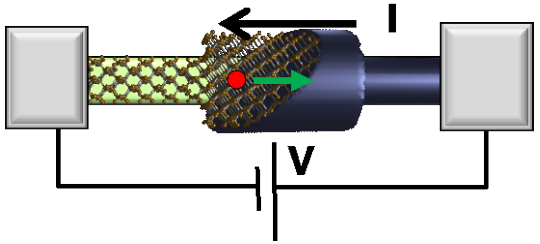

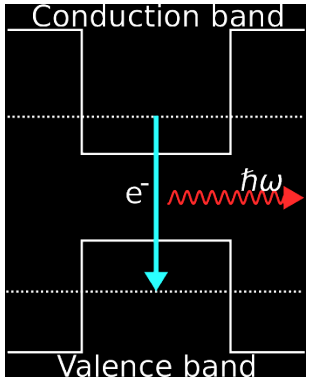

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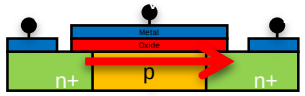

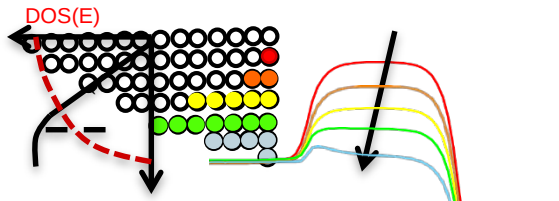

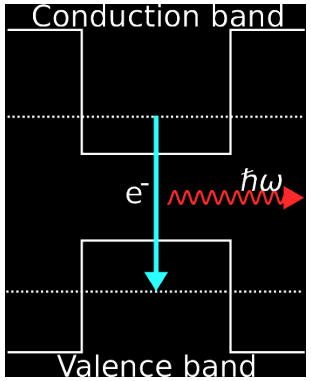

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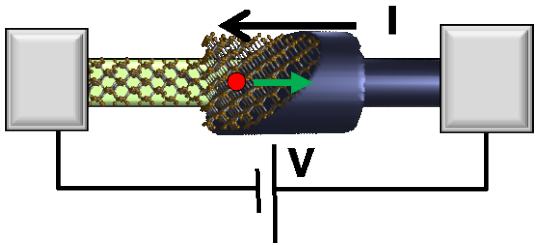

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