



Fundamentals of Optoelectronics

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Real-World Optoelectronic Devices (1)

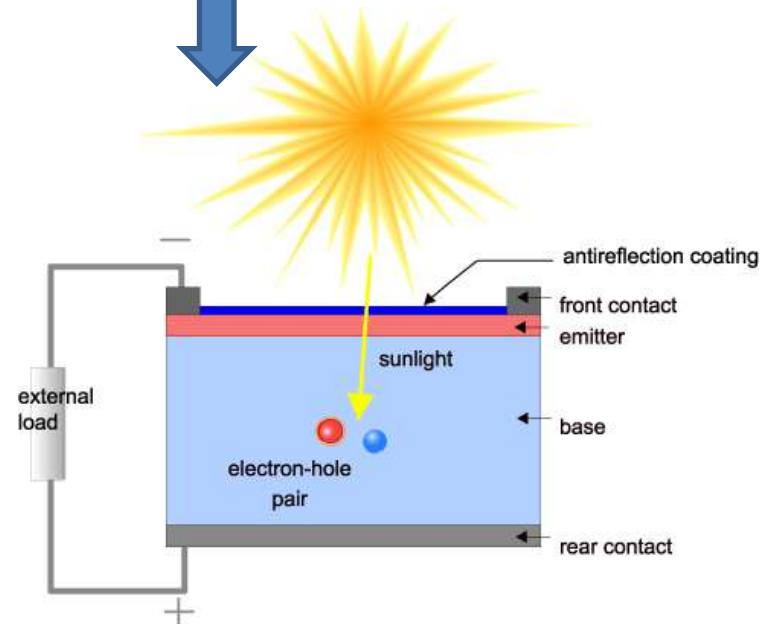


Carbon Neutrality

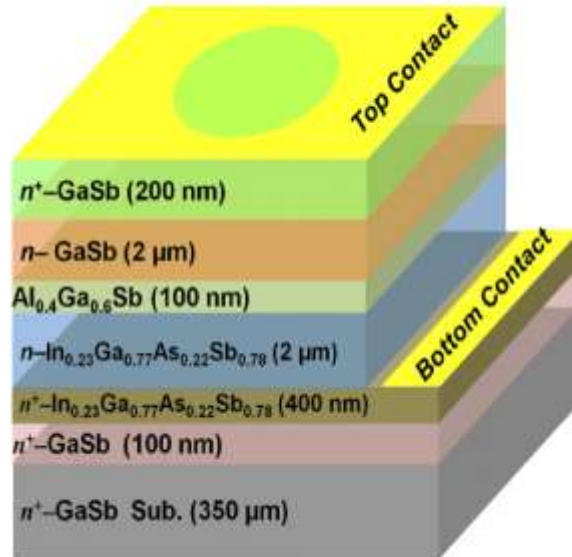
2020: Wind 13%, Solar 11%,
Hydro 17%, Thermal 49%

2060: Wind 31%, Solar 47%.

Green Energy
&
Solar Cells



Real-World Optoelectronic Devices (2)



Infrared Guiding Missile & Photodetectors

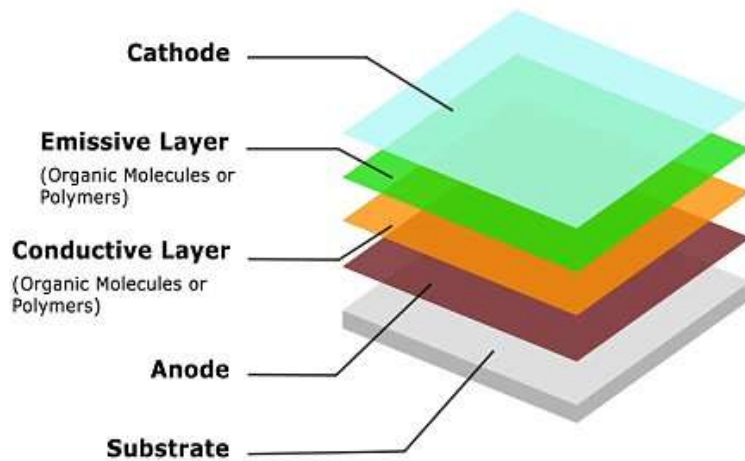
What is fundamental law behind?

Real-World Optoelectronic Devices (3)



Huawei Mate 70 RS

OLED structure



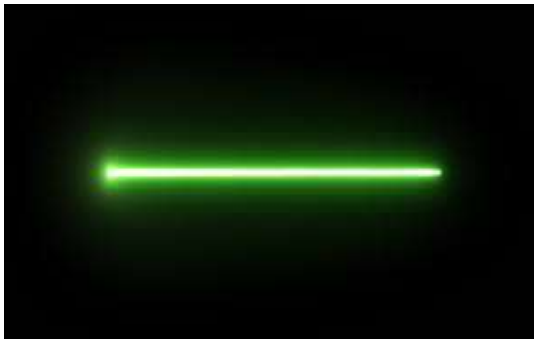
Flexible Display
&
Light Emitting Diode

Real-World Optoelectronic Devices (4)

controlled nuclear fusion



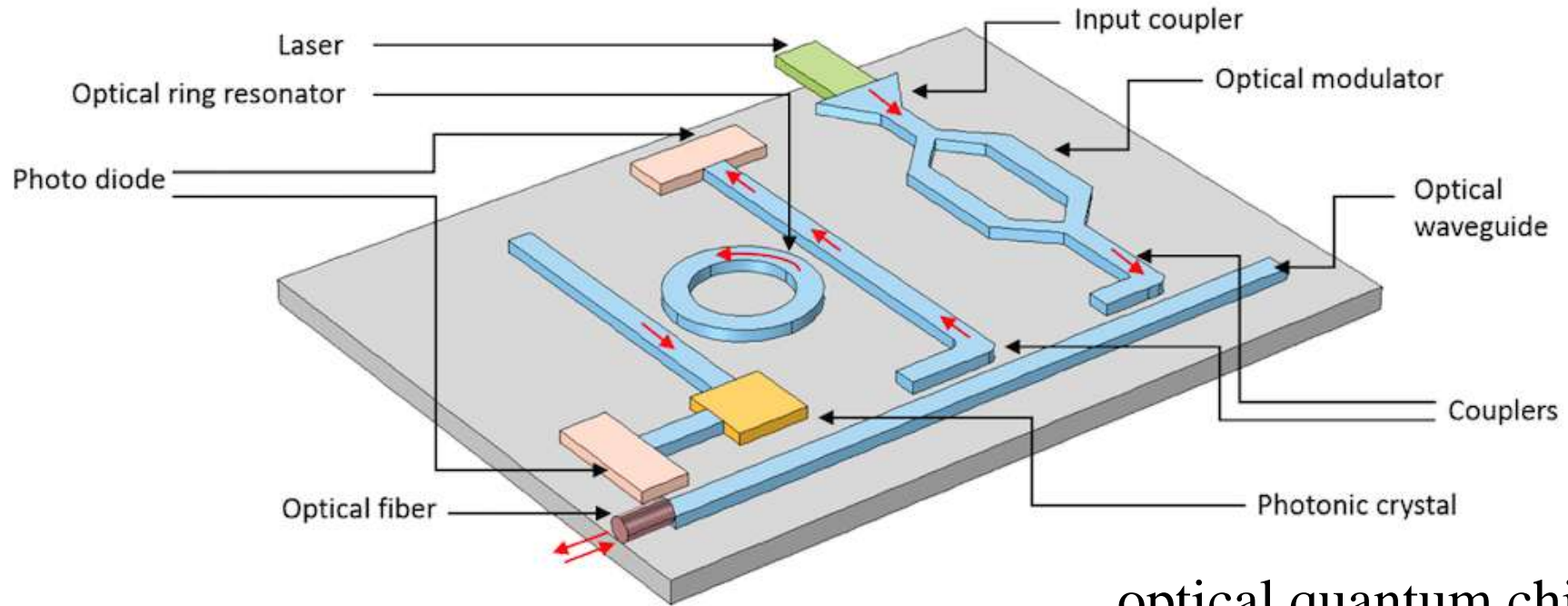
Solutions to the AI-Induced Energy Crisis



National Ignition Facility
&
Laser

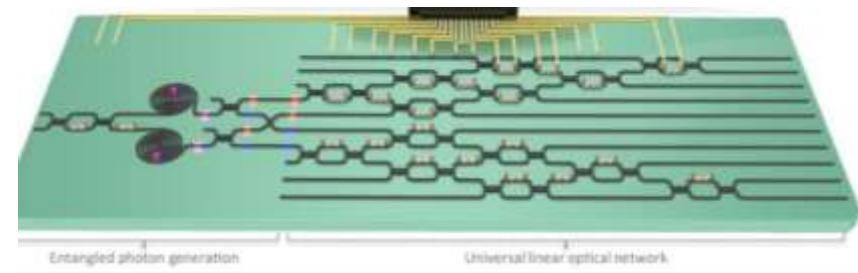
Real-World Optoelectronic Devices (5)

photonic integrated circuit/optoelectronic chip



optical quantum chip

perform various optical operations, such as focusing, splitting, isolation, polarization, coupling, modulation, and (eventually) detecting light



What are the Optoelectronic Devices?

1. Convert light into electrical energy or
Convert electrical energy into light
2. Light involved electronics
3. Devices governed by both Maxwell's
equations (optics or electromagnetics) and
Semiconductor equations (electronics)

[Introduction Video](#)

- 1. Objective**
- 2. Logistics (Pre-requisite, Grading, Textbook, Reference)**
- 3. Syllabus**

1. Objective

1. Understand wave physics in multilayer device structures
2. Understand semiconductor physics of P-N junction
3. Understand working principles of solar cells, photodetectors, light emitting diodes, lasers, and optoelectronic chips.
4. Know basic governing equations of optoelectronics (optional)
5. Know device physics and design routes of solar cells, photodetectors, light emitting diodes, lasers, and optoelectronic chips.

One of the following pre-requisites must be satisfied:

1. Know fundamentals of electromagnetics (EM fields and Waves)
2. Know fundamentals of analog circuit (P-N junction)

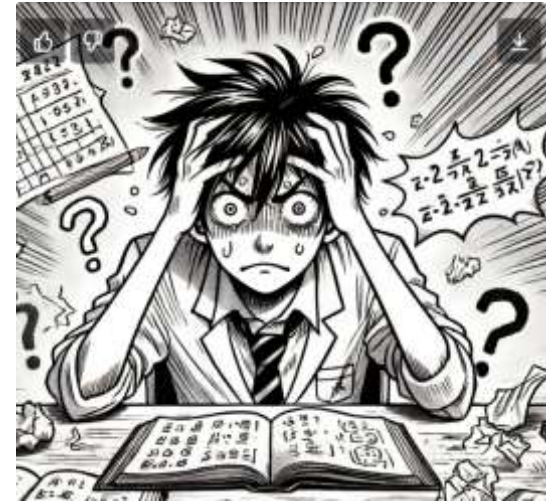
2. Logistics — Grading

Question and Answer = 10%

Quiz = 10%

Assignment = 30%

Training Project = 50%



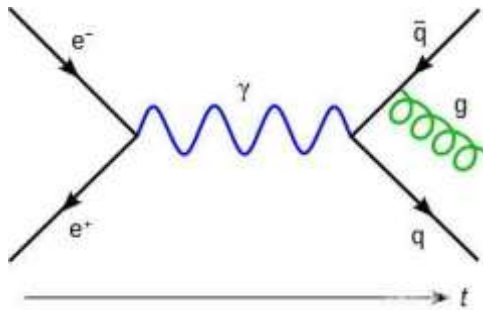
2. More on Grading (by Richard Phillips Feynman)



epilogue

Finally, may I add that the main purpose of my teaching has not been to prepare you for some examination—it was not even to prepare you to serve industry or the military. I wanted most to give you some appreciation of the wonderful world and the physicist's way of looking at it, which, I believe, is a major part of the true culture of modern times. (There are probably professors of other subjects who would object, but I believe that they are completely wrong.)

Perhaps you will not only have some appreciation of this culture; it is even possible that you may want to join in the greatest adventure that the human mind has ever begun.



我讲授的主要目的，不是帮助你们应付考试，也不是帮你们为工业或国防服务。我最希望做到的是，让你们欣赏这奇妙的世界以及物理学观察它的方法

2. Logistics — Textbook and Reference

Textbook

Optoelectronics and Photonics: Principles and Practices, Second Edition, S. O. Kasap, Prentice Hall, 2001.

References

半导体物理学 (第7版), 刘恩科著. 电子工业出版社, 2008.

电磁场与电磁波, 谢处方、饶克谨编著, 高等教育出版社, 2006.

Optics, 5th Edition, Eugene Hecht, Pearson, 2016.

Advanced References

Physics of Photonic Devices, Second Edition, Shun Lien Chuang, Wiley, 2009.

光电子技术基础, 朱京平编著. 科学出版社, 2003年9月第1版, ISBN: 7-03-011657-7

Waves and Fields in Optoelectronics, Hermann A. Haus, Prentice Hall, 1983.

3. Syllabus

1. Fundamental of electromagnetics and wave physics in multilayer device structures (15 class hours)
2. Semiconductor physics and P-N junction (9 class hours)
3. Solar cell and Photodetector (9 class hours)
4. Light emitting diode (3 class hours)
5. Laser (9 class hours)
6. Optoelectronic chip (3 class hours)