通識中心課程-自然與工程科學類

光電科技導論

張世慧 副教授

成大光電

光電系

光電科技導論介紹

- ✓ 通識中心課程-自然與工程科學類
- ✓ 學分:2
- ✓ 授課老師：張世慧
- ✓ 上課時間: 每星期二下午1:10-3:00
- ✓ 上課地點：綜合大樓48312教室
- ✓ 聯絡方式：辦公室綜合大樓48411室;分機63920
- ✓ email: gilbert@mail.ncku.edu.tw

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課程概述及教學目標

介紹各種光電科技，使學生瞭解其基本原理及光電科技之應用。希望以以淺顯易懂的方式逐步說明並介紹各式光電應用產品。

課程的目的在增進學生的光電基本常識，使學員都能具備宏觀的光電視野，可以活用且不懼怕使用生活中的各項光電產品。

- 主要教材：

  自編課程講義，可由數位學習平台NCKU moodle下載 (http://moodle.ncku.edu.tw/)

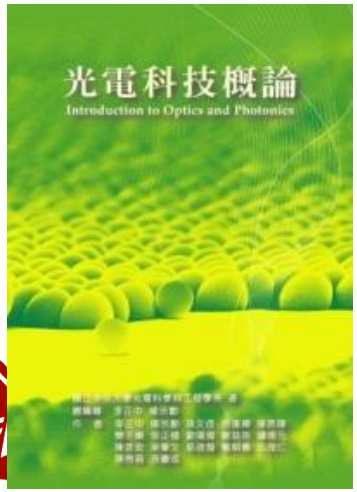
- 參考教材 ：

1. 光電科技與新儲存產業/曲威光/全華圖書/2010.
2. 當代光電工程(第二版)/廖顯奎/滄海2010.
3. 光電科技概論(二版)/五南出版社/李正中等/2011.
4. Optoelectronics and Photonics, S. O. Kasap, Prentice Hall, 2001.

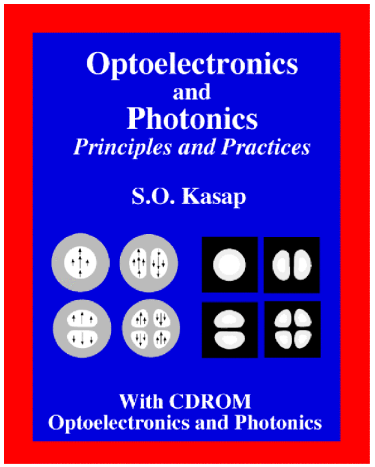
主要參考書籍

光電科技與新儲存產業/全華/曲威光 2010

當代光電工程第二版/滄海/廖顯奎 2010



光電科技概論(二版)/五南出版社/李正中等/2011



Optoelectronics and Photonics," S. O. Kasap,Prentice Hall, 2001

光電系

評分方法

- ❖ 期中考: 25%
- ❖ 期末考: 25%
- ❖ 小組報告及小組討論分享: 30%
- ❖ 個人報告及問答:10%
- ❖ 出席：10 %

1. 不定期點名。
2. 課堂回答問題後，寫下姓名、學號、問題及答案，下課後交予老師。1題占總成績2分。
3. 光電新聞時事：與當週內容相關之新聞報導，上傳moodle並在課堂分享。

✓ 請假規則：請於事前email至gilbert@mail.ncku.edu.tw請假。除非特殊狀況，不接受事後請假。

✓ 期中、期末考不單獨提前或延後考，特殊狀況除外。

小組分組

- 6人為一組
- 不同科系
- 至少一~二位女同學
- (人文社會管理) 與 (理工醫)約 1:1比例

小組討論

- 我為什麼要修這堂 光電科技導論通識課?
- 我想從這堂課 學到什麼?
- 我日常生活中有哪些光電相關的產品及應用?

內容介紹

- 光電與諾貝爾獎
- 光電產業現況簡介、光與生活
- 光是什麼 ---光的特性介紹
- 我把光電元件變小了---光電半導體及製造技術
- 照亮未來 ---發光二極體及固態照明
- 多采多姿的雷射---雷射及其應用
- 太陽能，台灣能不能---太陽光電

內容介紹（II）

- 小就是美---奈米光電(1)(2)(3)(4)
- 每天見面的朋友:螢幕---光顯示器技術
- 古沙遞捷音---光纖原理與應用
- VCD? DVD？ 藍光DVD?---光儲存技術
- 捕捉絢爛的那一刻---光偵測技術
- 光電醫療、檢測及影像---生醫光電

各週課程預定進度

週次	上課日期	課程進度、內容、主題
1	03月3日	課程介紹、光電與諾貝爾獎
2	03月10日	光電產業現況簡介
3	03月17日	光與生活 、光的特性介紹
4	03月24日	光電半導體及製造技術簡介
5	03月31日	發光二極體及固態照明
6	04月07日	雷射I
7	04月14日	雷射II
8	04月21日	太陽能光電
9	04月28日	期中考
10	05月05日	色彩學
11	05月12日	光顯示器技術
12	05月19日	光纖原理與應
13	05月26日	用光偵測技術 光儲存技術
14	06月02日	生醫光電
15	06月09日	奈米光電(1) 簡介與奈米製程
16	06月16日	奈米光電(2)綠能應用
17	06月23日	奈米光電(3)生醫檢測與影像應用
18	06月30日	期末考

光電與諾貝爾獎

Year	Nobel Laureates	Contributions
1901	Wilhelm Conrad Röntgen	"in recognition of the extraordinary services he has rendered by the discovery of the remarkable rays subsequently named after him."
1902	Hendrik Antoon Lorentz, Pieter Zeeman	"in recognition of the extraordinary service they rendered by their researches into the influence of magnetism upon radiation phenomena."
1904	Lord Rayleigh (John William Strutt)	"for his investigations of the densities of the most important gases and for his discovery of argon in connection with these studies."
1907	Albert Abraham Michelson	"for his optical precision instruments and the spectroscopic and metrological investigations carried out with their aid"
1908	Gabriel Lippmann	"for his method of reproducing colours photographically based on the phenomenon of interference."
1909	Guglielmo Marconi Karl Ferdinand Braun	"in recognition of their contributions to the development of wireless telegraphy."
1914	Max von Laue	"for his discovery of the diffraction of X-rays by crystals."
1915	Sir William Henry Bragg William Lawrence Bragg	"for their services in the analysis of crystal structure by means of X-rays."
1918	Max Planck	"in recognition of the services he rendered to the advancement of Physics by his discovery of energy quanta."
1919	Johannes Stark	"for his discovery of the Doppler effect in canal rays and the splitting of spectral lines in electric fields."

光電與諾貝爾獎

Year	Nobel Laureates	Contributions
1921	Albert Einstein	for his services to Theoretical Physics, and especially for his explanation of the photoelectric effect
1922	Niels Bohr	"for his services in the investigation of the structure of atoms and of the radiation emanating from them."
1923	Robert Andrews Millikan	"for his work on the elementary charge of electricity and on the photoelectric effect"
1930	Sir Chandrasekhara Venkata Raman	"for his work on the scattering of light and for the discovery of the effect named after him"
1932	Werner Heisenberg	"for the creation of quantum mechanics, the application of which has, inter alia, led to the discovery of the allotropic forms of hydrogen."
1933	Erwin Schrödinger & Paul Adrien Maurice Dirac	"for the discovery of new productive forms of atomic theory."
1944	Isidor Isaac Rabi	"for his resonance method for recording the magnetic properties of atomic nuclei."
1953	Frederik Zernike	"for his demonstration of the phase contrast method, especially for his invention of the phase contrast microscope"
1954	Max Born	(one half of the prize)"for his fundamental research in quantum mechanics, especially for his statistical interpretation of the wave function."
1955	Willis Eugene Lamb	"for his discoveries concerning the fine structure of the hydrogen spectrum"

光電與諾貝爾獎

Year	Nobel Laureates	Contributions
1963	Sir John Carew Eccles Alan Lloyd Hodgkin Andrew Fielding Huxley	"for their discoveries concerning the ionic mechanisms involved in excitation and inhibition in the peripheral and central portions of the nerve cell membrane." (Physiology or Medicine)
1964	Charles H. Townes Nicolay Basov Aleksandr Prokhorov	for fundamental work in the field of quantum electronics, which has led to the construction of oscillators and amplifiers based on the maser-laser principle
1965	Richard P. Feynman Julian Schwinger Sin-Itiro Tomonaga	"for their fundamental work in quantum electrodynamics, with deep-ploughing consequences for the physics of elementary particles."
1966	Alfred Kastler	for the discovery and development of optical methods for studying Hertzian resonances in atoms
1967	Ronald George Wreyford Norrish & George Porter	"for their studies of extremely fast chemical reactions, effected by disturbing the equlibrium by means of very short pulses of energy." (chemistry)
1971	Dennis Gabor	for his invention and development of the holographic method
1981	Nicolaas Bloembergen Arthur L. Schawlow	for their contribution to the development of laser spectroscopy
1997	Steven Chu Claude Cohen-Tannoudji William D. Phillips	for development of methods to cool and trap atoms with laser light
1999	Ahmed H. Zewail	for his studies of the transition states of chemical reactions using femtosecond spectroscopy （化學獎）

光電與諾貝爾獎

Year	Nobel Laureates	Contributions
2000	Zhores I. Alferov Herbert Kroemer	*"for basic work on information and communication technology"* *for developing semiconductor heterostructures used in high-speed- and opto-electronics*
2001	Eric Cornell , Wolfgang Ketterle , Carl Wieman	"for the achievement of Bose-Einstein condensation in dilute gases of alkali atoms, and for early fundamental studies of the properties of the condensates"
2005	John L. Hall, Theodor W. Hänsch	for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique
2006	John C. Mather, George Smoot	"for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation."
2008	Martin Chalfie, Osamu Shimomura Roger Y. Tsien	"for the discovery and development of the green fluorescent protein, GFP." (Chemistry)
2009	Charles K. Kao Willard S. Boyle George E. Smith	for groundbreaking achievements concerning the transmission of light in fibers for optical communication for the invention of an imaging semiconductor circuit – the CCD sensor
2012	David J. Wineland	"for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems"
2014	Isamu Akasaki, Hiroshi Amano, Shuji Nakaura	for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources"
2014	Eric Betzig, Stefan W. Hell, William E. Moerner	for the development of super resolved fluorescence microscopy

2014年 諾貝爾物理獎

Isamu Akasaki

Hiroshi Amano

Shuji Nakaura

When Isamu Akasaki, Hiroshi Amano and Shuji Nakamura produced bright blue light beams from their semi-conductors in the early 1990s, they triggered a fundamental transformation of lighting technology. Red and green diodes had been around for a long time but without blue light, white lamps could not be created. Despite considerable efforts, both in the scientific community and in industry, the blue LED had remained a challenge for three decades.

They succeeded where everyone else had failed. Akasaki worked together with Amano at the University of Nagoya, while Nakamura was employed at Nichia Chemicals, a small company in Tokushima. Their inventions were revolutionary. Incandescent light bulbs lit the 20th century; the 21st century will be lit by LED lamps.

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2014年 諾貝爾化學獎

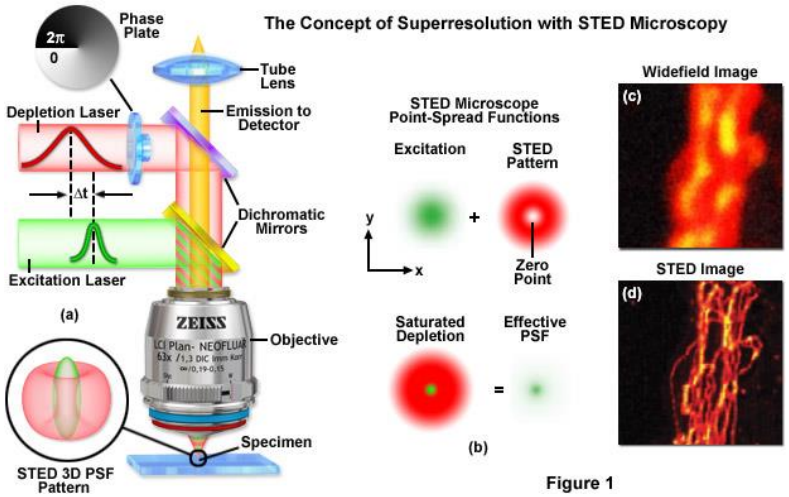

Figure 1

Stefan W. Hell

Eric Betzig

William E. Moerner

For a long time optical microscopy was held back by a presumed limitation: that it would never obtain a better resolution than half the wavelength of light. Helped by fluorescent molecules the Nobel Laureates in Chemistry 2014 ingeniously circumvented this limitation. Their ground-breaking work has brought optical microscopy into the nanodimension.

Two separate principles are rewarded. One enables the method *stimulated emission depletion (**STED**) microscopy*, developed by Stefan Hell in 2000. Two laser beams are utilized; one stimulates fluorescent molecules to glow, another cancels out all fluorescence except for that in a nanometre-sized volume. Scanning over the sample, nanometre for nanometre, yields an image with a resolution better than Abbe's stipulated limit.

Eric Betzig and William Moerner, working separately, laid the foundation for the second method, ***single-molecule microscopy***. The method relies upon the possibility to turn the fluorescence of individual molecules on and off. Scientists image the same area multiple times, letting just a few interspersed molecules glow each time. Superimposing these images yields a dense super-image resolved at the nanolevel. In 2006 Eric Betzig utilized this method for the first time.

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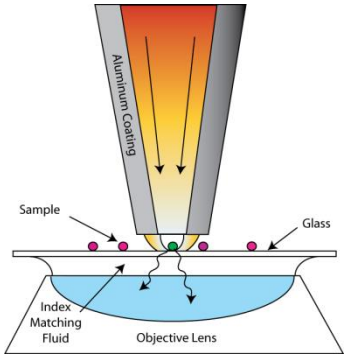

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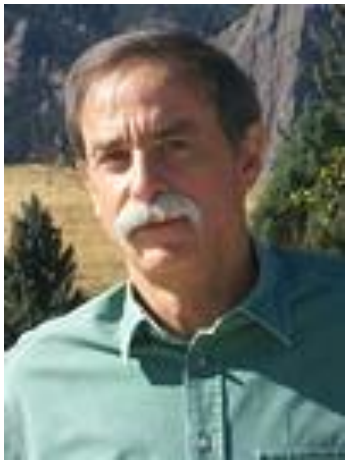
2012年 諾貝爾物理獎

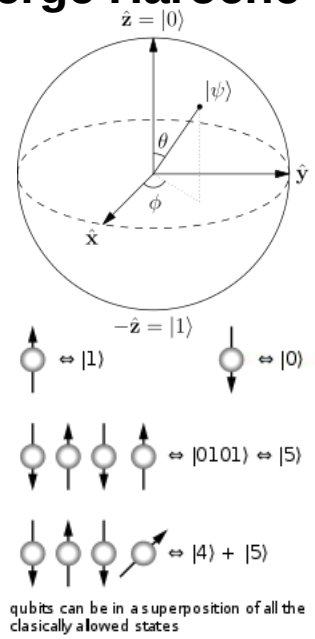


David J. Wineland

Serge Haroche

■ The two researchers use opposite approaches to examine, control and count quantum particles. Wineland traps ions — electrically charged atoms — and measures them with light. Haroche controls and measures photons, or light particles, by sending atoms through a specially prepared trap.

■ Trapping single atoms could help pave the way to superfast quantum computers (qubits -- quantum bits). Quantum encryption could open the way for a new generation of secure communication tools.



http://www.nbcnews.com/id/49339942/ns/technology_and_science-science/#.USLwtqWxV8E and wilipedia.com

2009年 諾貝爾物理獎

Charles K. Kao
高錕爵士

Willard S. Boyle

George E. Smith

- One half awarded to Charles K. Kao *"for groundbreaking achievements concerning the transmission of light in fibers for optical communication"*,

■ The other half jointly to Willard S. Boyle and George E. Smith *"for the invention of an imaging semiconductor circuit – the CCD sensor"*.

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2005年 諾貝爾物理獎

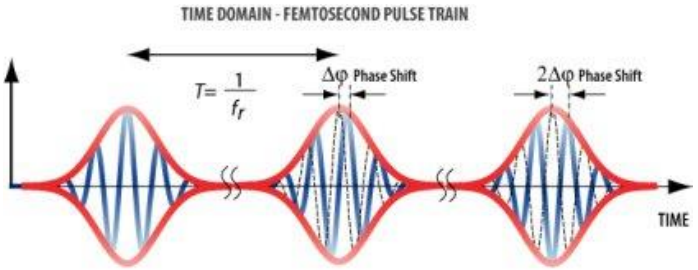
Roy J. Glauber

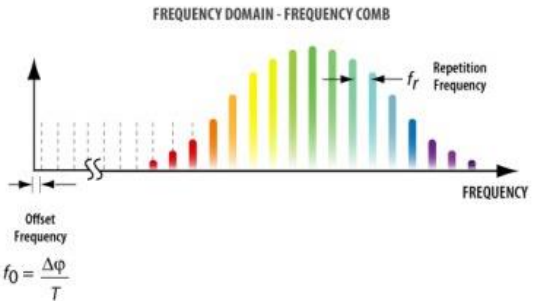
Theodor W. Haensch

John L. Hall

- "for his contribution to the quantum theory of optical coherence"

■ "for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique"





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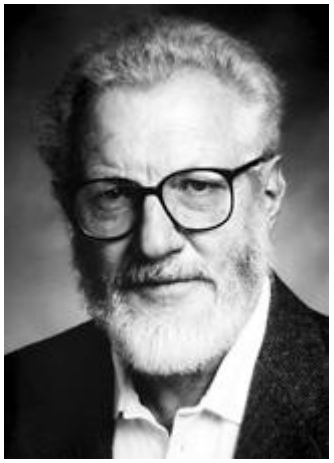
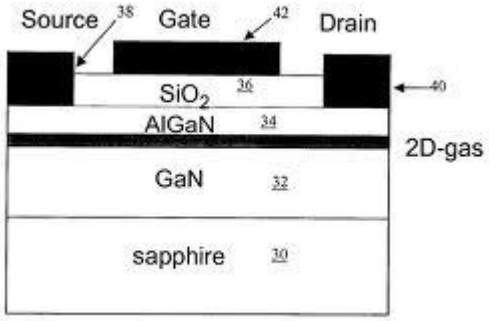
2000年 諾貝爾物理獎

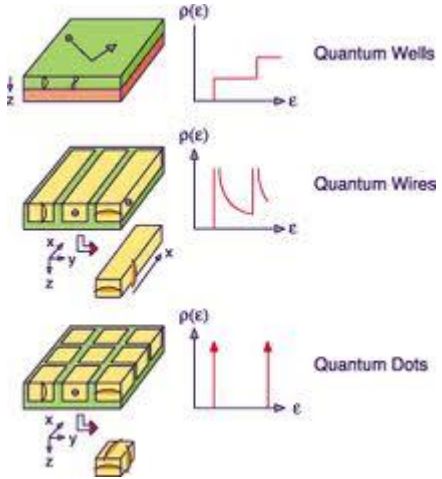
Zhores I. Alferov



Herbert Kroemer

- basic work on information and communication technology for developing semiconductor heterostructures used in high-speed- and opto-electronics





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參考資料:
介紹歷屆諾貝爾獎得主及其演講

www.nobelprize.org/nobel_prizes/physics/laureates/

Nobelprize.org
The Official Web Site of the Nobel Prize

PHYSICS PRIZE: Serge Haroche, David J. Wineland
CHEMISTRY PRIZE: Robert J. Lefkowitz, Brian K. Kobilka
MEDICINE PRIZE: Sir John B. Gurdon, Shinya Yamanaka
LITERATURE PRIZE: Mo Yan
PEACE PRIZE: European Union
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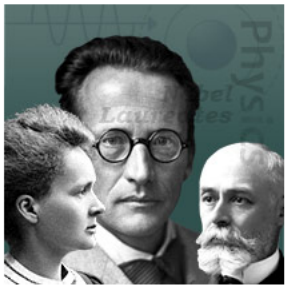

All Nobel Prizes in Physics

The Nobel Prize in Physics has been awarded 106 times to 194 Nobel Laureates between 1901 and 2012. John Bardeen is the only Nobel Laureate who has been awarded the Nobel Prize in Physics twice, in 1956 and 1972. This means that a total of 193 individuals have received the Nobel Prize in Physics. Click on the links to get more information.

- 2012 Serge Haroche, David J. Wineland
- 2011 Saul Perlmutter, Brian P. Schmidt, Adam G. Riess
- 2010 Andre Geim, Konstantin Novoselov
- 2009 Charles Kuen Kao, Willard S. Boyle, George E. Smith
- 2008 Yoichiro Nambu, Makoto Kobayashi, Toshihide Maskawa
- 2007 Albert Fert, Peter Grünberg
- 2006 John C. Mather, George F. Smoot
- 2005 Roy J. Glauber, John L. Hall, Theodor W. Hänsch
- 2004 David J. Gross, H. David Politzer, Frank Wilczek
- 2003 Alexei A. Abrikosov, Vitaly L. Ginzburg, Anthony J. Leggett
- 2002 Raymond Davis Jr., Masatoshi Koshiba, Riccardo Giacconi
- 2001 Eric A. Cornell, Wolfgang Ketterle, Carl E. Wieman

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諾貝爾獎官方 App：介紹歷屆諾貝爾獎得主

http://www.osa.org/en-us/about_osa/osa_nobel_laureates/

參考資料:
美國光學學會網站介紹歷屆有關光學的諾貝爾獎得主

www.osa.org/en-us/about_osa/osa_nobel_laureates/

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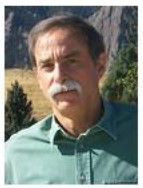
Nobel Laureates

Intro

Over the course of OSA's nearly one hundred year history, 31 OSA members have been awarded a Nobel Prize in Physics, Chemistry or Physiology/Medicine. For a complete list of the Nobel Laureates in each category, click on the subject name below.

Physics

David J. Wineland (2012)
OSA Fellow



"for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems"

Willard S. Boyle (2009)
OSA Member

"for the invention of an imaging semiconductor circuit - the CCD sensor"

Charles K. Kao (2009)
OSA Member

"for groundbreaking achievements concerning the transmission of light in fibers for optical communication"

George E. Smith (2009)
OSA Member

"for the invention of an imaging semiconductor circuit - the CCD sensor"

John C. Mather (2006)
OSA Fellow

Roy J. Glauber (2005)
OSA Honorary Member

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小組作業:(Due: 2周後3/17)

用相機/手機 收集身旁周遭的光電產品
做成ppt 上傳至moodle