电子科学与技术专业英语

光电子技术分册

总主编　张爱红
主　编　林殿阳

哈尔滨工业大学出版社

专业英语阅读丛书

●电子科学与技术专业英语	全套48.00元
光电子技术分册	
微电子技术分册	
光电信息技术分册	
对外贸易英文函电	12.00元
国际商贸英语	15.00元
力学专业英语	12.00元
信息功能材料专业英语	13.80元
土木工程专业英语（第二版）	12.80元
机电工程专业英语（第三次修订）	12.00元
机械工程专业英语（第三版）	13.80元
热能与动力工程专业英语	14.00元
电子信息与通信专业英语	12.00元
环境科学与工程专业英语	12.00元
材料科学与工程专业英语（修订版）	13.80元
计算机专业英语（修订版）	11.00元
建筑工程专业英语	11.50元
电气自动化专业英语	13.80元
外贸英语阅读	8.50元
汽车英语阅读	17.50元
会计英语阅读	12.80元
经济专业英语阅读	14.80元
自动控制专业英语阅读	13.80元
应用化学专业英语	17.00元
管理类专业英语阅读	估12.80元

责任编辑　张晓京
封面设计　卞秉利

ISBN 7-5603-1833-9

9 787560 318332 >

ISBN 7-5603-1833-9 / TN·65
全套（三册）定价 48.00元

电子科学与技术专业英语

光电子技术分册

总主编　张爱红
主　编　林殿阳

哈尔滨工业大学出版社
哈尔滨

图书在版编目(CIP)数据

光电子技术专业英语/张爱红主编.—哈尔滨:哈尔滨工业大学出版社,2003.4

ISBN 7-5603-1833-9

Ⅰ.光… Ⅱ.张… Ⅲ.光电子技术-英语 Ⅳ.H31

中国版本图书馆 CIP 数据核字(2003)第 018235 号

出版发行 哈尔滨工业大学出版社
社　　址 哈尔滨市南岗区教化街 21 号　邮编 150006
传　　真 0451-6414749
印　　刷 哈尔滨市龙华印刷厂
开　　本 850×1168　1/32　印张 15.25　字数 388 千字
版　　次 2003 年 4 月第 1 版　2003 年 4 月第 1 次印刷
书　　号 ISBN 7-5603-1833-9/TN·65
印　　数 1~3 000
定　　价 全套(三册)定价 48.00 元　本册定价 16.00 元

前　言

21 世纪是国际化的高科技时代、信息时代，作为国际间交流的重要载体——英语，其作用显得更为重要。专业英语是大学英语教学的重要组成部分，其目的是强化巩固基础英语并进行实践应用，从而掌握科技英语技能，使学生能够熟练阅读国外相关文献，掌握国内外本专业发展前沿的最新动态，并且有一定的科技写作能力。为此我们编写这套专业英语教材，以满足高等院校电子科学与技术和电子信息科学与技术专业及相关专业的本科生专业英语教学的需要，以及从事上述专业的工程技术人员学习英语的要求。全套教材分三册，包括光电子技术分册、微电子技术分册和光电信息技术分册。

本书是光电子技术分册，内容共分为五部分：第一部分为激光的基本理论，主要内容包括：激光器的基本原理，激光束的特性，光学谐振腔中的激光振荡，激光器的类型；第二部分为激光输出控制，主要内容包括：调 Q 技术、调制技术、偏转技术、倍频技术、稳频技术和选模技术等；第三部分为非线性光学，主要内容包括：非线性光学效应，光学相位共轭；第四部分为激光应用，主要内容包括：激光材料加工，激光干涉测量，激光雷达，光通信，全息术以及激光在其他方面的应用；第五部分为科技文献范例。

书中的内容全部选自英文原文，考虑到篇幅的限制及上下文的连惯性，对所选内容的图表及文字进行了部分删减和改动。为

了有利于教学和阅读理解，帮助学生更好地理解原文，每章后面给出了主要专业词汇及难句注释，并在每部分后面列出了有关参考文献。

本书是根据编者在专业英语方面的长期教学经验和体会编写而成的，内容较多，教师可以根据实际教学时数和需要选取合适的章节作为课堂教学内容，其他部分可作为学生课后阅读材料。对于其他专业的读者，也可通过阅读本书对光电子学原理及其应用有一定的了解和认识，既学习了英语，又开阔了视野。

本分册由林殿阳教授担任主编并编写了第1~4章、第6章、第7章及范例2和范例3；本书的第5章由夏元钦副教授编写；第8章及第10章由李琦副教授编写；第9章由申作春副教授编写；第11章由谭立英教授编写；第12章、第13章及范例1由赵永蓬讲师编写。王骐教授担任主审，并提出了许多宝贵意见。

本书在编写过程中得到于欣副教授以及电子科学与技术系、光电子技术教研室的许多老师及学生的大力支持，在此一并表示诚挚的感谢。由于编者水平有限，书中难免存在一些缺点和疏漏，殷切希望广大读者批评指正。

编　者

2003年3月

CONTENTS

PART THREE NONLINEAR OPTICS

PART ONE
LASER PRINCIPLES

Chapter 1

Fundamentals of Lasers

1.1 The Nature of Light

In order to understand how a laser works it will be useful to recount how present ideas concerning the nature of light have come about. Of all man's senses that of vision is the most important. The connection between vision and the rising and the setting of the sun was probably one of the first scientific deductions made by man. The Greeks were almost certainly the first to try to explain how vision takes place and consequently to conjecture on the nature of light itself. They had two theories: first that the eye reached out by means of probes or tentacles and touched the object which was thus 'seen'. Secondly that the object itself emitted some sort of material which was collected by the eye to give the sensation of vision. These theories are referred to as the tactile and emission theories.

The advent of experimental science in the 17th century brought about the abandonment of the tacile theory and the development of two emission theories each passionately defended by their respective proponents. These two emission theories were the corpuscular theory of Isaac Newton and the wave theory of Robert Hooke and Christian Huygens.

Even at that time a considerable amount of experimental data was available. Reflection and refraction had been known from antiquity. Interference(although it was not referred to as such until Thomas Young propounded his theories in the early 19th century) had been observed independently by Hooke and Robert Boyle in 1665 in the form of the somewhat unfairly named Newton's rings. In the same year diffraction had been observed by Grimaldi. Four years later Bartholinus discovered double refraction in a crystalline material called Iceland spar.

The wave theory, initially proposed in a primitive form by Hooke, then advanced and refined by Huygens, accounted very well for reflection, refraction and double refraction and the latter led Huygens to the conclusion that in some way light could be polarized in different directions. Huygens based his explanations on the principle that every point on a wavefront acted as a secondary source of spherical waves which were propagated through an all pervading medium called the aether. At that time transverse waves, where the direction of vibration is at right angles to the direction of propagation, were well known in the form of water waves. Also familiar as sound waves were longitudinal waves. In this type of wave the direction of vibration is parallel to the direction of propagation. That light waves were longitudinal in nature was universally accepted by the suppirters of the wave theory. This seems an odd choice as variation in polarization can be explained elegantly on a transverse wave theory but is quite inexplicable in the case of longitudinal waves. It may be that the association of sound and vision led to the idea that the waves in each case must be of the same type.

This inability to account for variations in polarization on a longitudinal wave theory led Newton to devise a corpuscular explanation Newton thought of light as particles obeying his dynamical laws of motion and accounted for rectilinear propagation by assuming that the light particles had no mass and so, according to his laws of motion, could not be changed from their straight line trajectories by any impressed forces. Newton thought that rectilinear propagation was inconsistent with a wave theory as a light wave would be expected to diffract, i. e., to spread round corners and he devised ingenious explanations to account for Grimaldi's earlier observations. Newton was, of course, quite correct in thinking that light waves must exhibit diffraction but he failed to realise that if the wavelength is small enough any such diffraction would be extremely difficult to observe.

For a century or so the might of Newton's authority held sway and the wave theory did not obtain general acceptance, albeit with some notable exceptions; particularly that of the mathematician Euler, who correctly associated waves of different frequencies with different colours.

In 1801 Thomas Young in his classical two-slit experiment showed that light from two sources could combine to form regions of brightness and darkness called fringes. These could only be explained in terms of a wave theory, a bright fringe being formed where the two waves combine in phase so as to reinforce one another; and dark fringes being formed where the two waves find themselves out of phase and hence cancelling each other. Young termed these phenomena constructive and destructive interference respectively.

The colours seen when thin films are illuminated with white light were also explained by Young in terms of a wave theory where, like Euler, he associated different colours with different wavelengths. At about the same time Malus discovered polarization by reflection and in 1816 Fresnel and Arago showed that two waves polarized at right angles could not interfere. Young suggested that the only possible explanation for these observations was that light must not only be a wave but that, in addition, it had to be of a transverse nature.

Additional evidence in favour of the wave theory was provided by Fresnel, who explained diffraction quantitatively on the wave theory. Further conclusive proof was obtained in 1850, when Foucault measured the speed of light in air and water. According to the corpuscular theory the denser material would attract the corpuscles hence speeding up the light, whereas on the wave theory the converse would be true. Foucault found that the speed of light in air was faster than in water and thus disproved the corpuscular theory.

A dramatic advance in the understanding of light resulted from the work on electricity and magnetism by Faraday, Oersted and Henry. In 1864 James Clerk Maxwell combined all the experimental data into a set of equations. From this set of equations could be deduced the existence of a wave with the property that its speed, c, in free space bore a simple relationship to the dielectric constant (permittivity), ε_0 and the magnetic permeability μ_0. This relationship is expressed in equation 1.1:

$$c = \sqrt{\frac{1}{\mu_0 \varepsilon_0}} \tag{1.1}$$

Now the extraordinary property of this wave was that on substituting known values for μ_0 and ε_0 in equation 1.1 a result identical to the velocity of light in a vacuum was obtained, the