机械工程英语阅读教程

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東華大學出版社

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编写说明

随着中国加入世贸组织，中国经济快速发展，经济全球化等，这些大背景给学生带来了更广阔的就业平台。但同时，对学生的英语水平也有了更高的要求。熟练的专业技术加上精良的专业英语知识无疑就是高技能、紧缺人才所必备的。因此，学好专业英语显得尤为重要。

本书是按照《高职高专院校机械工程类专业英语教学大纲》所编写的。编者在多年教学实践经验的基础上，力求按照行业培养的宽口径，使专业英语教材具有良好的通用性。并根据高职高专教育的应用性特征，使专业英语具有较强的实用性和针对性。

全书由材料科学、材料成形、机械制造、汽车、模具、机器人、CAD/CAM 等七部分组成，共分成七个单元。每个单元均由课文、词汇、注释、相关练习和参考译文等五个部分组成。内容以材料工程、机械设计、机械制造、机电一体化、汽车制造与维修、模具设计与制造、数控技术、计算机辅助设计与制造等专业技术及其最新发展讯息为主，对所选的阅读材料中出现的语言重点和难点做了详细的注释。选材精炼，课文后配有生词短语表、注释和相应的练习，促进学生"学必思考，学练结合"。书后附有参考译文和练习答案，便于学生理解和核查自己学习与掌握的内容。

本书可作为高职高专机械设计与制造类、机电控制等专业的教材，也可供工商管理专业、经济类专业和英语专业学生、技术人员学习参考。建议教师根据各专业的学生情况，可不受教材编排顺序的限制，进行适当筛选。对老师没有选用的单元，学生可根据自己的兴趣和需要自学其中的部分内容，以拓宽专业英语的知识面。

本书由江苏省扬州职业大学周益军博士(副教授)任主编;南通纺织职业技术学院单敏老师任第一副主编;扬州职业大学池寅生硕士(讲师)任第二副主编。参编人员还有扬州职业大学肖淑梅博士、卫玉芬博士、孔纪兰博士、朱丹凤硕士、徐小青硕士、刘敏硕士、赵翔硕士、南丽霞硕士、张承阳硕士以及张翔博士等。

具体编写分工为:第一单元由孔纪兰编写;第二单元由朱丹凤编写;第三单元由周益军编写;第四单元,肖淑梅;第五单元,池寅生;第六单元,卫玉芬;第七单元,徐小青。单敏同志对本教材的词汇和练习进行了认真设计与编写。

本书的编写工作得到了扬州职业大学领导的高度重视与支持。孟咸智副教授对本教材的编写提出了宝贵意见,在此表示衷心的感谢。由于编者的水平和经验有限,书中难免有缺陷和不足之处,恳请广大读者批评指正。

编　者

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Unit 1

Lesson 1 Materials Science

1 Materials science or materials engineering is an interdisciplinary field involving the properties of matter and its applications to various areas of science and engineering. This science investigates the relationship between the structure of materials at atomic or molecular scales and their macroscopic properties. It includes elements of applied physics and chemistry, as well as chemical, mechanical, civil and electrical engineering. With significant media attention focused on nanoscience and nanotechnology in recent years, materials science has been propelled to the forefront at many universities. It is also an important part of forensic engineering and failure analysis.

1. History

2 The material of choice of a given era is often its defining point; the Stone Age, Bronze Age, and Steel Age are examples of this. Materials science is one of the oldest forms of engineering and applied science, deriving from the manufacture of ceramics. Modern materials science evolved directly from metallurgy, which itself evolved from mining. A major breakthrough in the understanding of materials occurred in the late 19th century, when Willard Gibbs demonstrated that thermodynamic properties relating to atomic structure in various phases are related to the physical properties of a material. Important elements of modern materials science are a product of the space race: the understanding and engineering of the metallic alloys, and silica and carbon materials, used in the construction of space vehicles enabling the exploration of space. Materials science has driven, and been driven by, the development of revolutionary

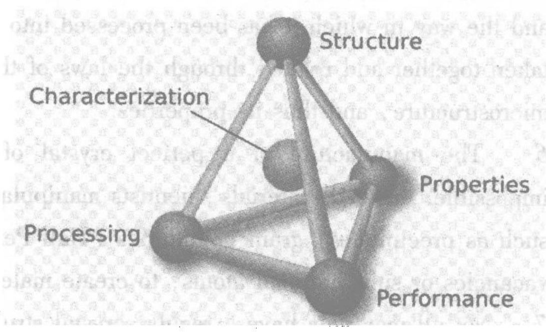

Fig. 1.1-1 The Materials Science Tetrahedron

technologies such as plastics, semiconductors, and biomaterials.

3 Before the 1960s (and in some cases decades after), many materials science departments were named metallurgy departments, from a 19th and early 20th century emphasis on metals. The field has since broadened to include every class of materials, including: ceramics, polymers, semiconductors, magnetic materials, medical implant materials and biological materials.

2. Fundamentals of materials science

4 In materials science, rather than haphazardly looking for and discovering materials and exploiting their properties, the aim is instead to understand materials so that new materials with the desired properties can be created.

5 The basis of materials science involves relating the desired properties and relative performance of a material in a certain application to the structure of the atoms and phases in that material through characterization. The major determinants of the structure of a material and thus of its properties are its constituent chemical elements and the way in which it has been processed into its final form. These characteristics, taken together and related through the laws of thermodynamics, govern a material's microstructure, and thus its properties.

6 The manufacture of a perfect crystal of a material is currently physically impossible. Instead materials scientists manipulate the defects in crystalline materials such as precipitates, grain boundaries (Hall-Petch relationship), interstitial atoms, vacancies or substitutional atoms, to create materials with the desired properties.

7 Not all materials have a regular crystal structure. Glasses, some ceramics, and many natural materials are amorphous, not possessing any long-range order in their atomic arrangements. Polymers display varying degrees of crystallinity, and many are completely non-crystalline. Polymers are studied in the fields of polymer chemistry, polymer physics, and polymer science.

3. Classes of materials (by bond types)

8 Materials science encompasses various classes of materials, each of which may constitute a separate field. Materials are sometimes classified by the type of bonding present between the atoms:

9 1) Ionic crystals

10 2) Covalent crystals

11 3) Metals

12 4) Intermetallics

13 5) Semiconductors

14 6) Polymers

15 7) Composite materials

16 8) Vitreous materials

4. Sub-fields of materials science

17 Nanotechnology — rigorously, the study of materials where the effects of quantum confinement, the Gibbs-Thomson effect, or any other effect only present at the nanoscale is the defining property of the material; but more commonly, it is the creation and study of materials whose defining structural properties are anywhere from less than a nanometer to one hundred nanometers in scale, such as molecularly engineered materials.

18 Microtechnology - study of materials and processes and their interaction, allowing microfabrication of structures of micrometric dimensions, such as Micro Electro Mechanical Systems (MEMS).

19 Crystallography — the study of how atoms in a solid fill space, the defects associated with crystal structures such as grain boundaries and dislocations, and the characterization of these structures and their relation to physical properties.

20 Materials Characterization — such as diffraction with x-rays, electrons, or neutrons, and various forms of spectroscopy and chemical analysis such as Raman spectroscopy, energy-dispersive spectroscopy (EDS), chromatography, thermal analysis, electron microscope analysis, etc., in order to understand and define the properties of materials.

21 Metallurgy — the study of metals and their alloys, including their extraction, microstructure and processing.

22 Biomaterials — materials that are derived from and/or used with biological systems.

23 Electronic and magnetic materials — materials such as semiconductors used to create integrated circuits, storage media, sensors, and other devices.

24 Tribology — the study of the wear of materials due to friction and other factors.

25 Surface science/Catalysis — interactions and structures between solid-gas solid-liquid or solid-solid interfaces.

26 Ceramography — the study of the microstructures of high-temperature materials and refractories, including structural ceramics such as RCC, polycrystalline silicon carbide and transformation toughened ceramics.

27 Glass Science — any non-crystalline material including inorganic glasses, vitreous metals and non-oxide glasses.

28 Forensic engineering — the study of how products fail, and the vital role of the materials of construction.

29 Forensic materials engineering — the study of material failure, and the light it sheds on how engineers specify materials in their product.

❖ New Words and Phrases

interdisciplinary [ˌintəˈdisiplinəri] *adj.*	各学科间的
molecular [məuˈlekjulə] *adj.*	分子的
macroscopic [ˌmækrəuˈskɔpik] *adj.*	宏观的
civil and electrical engineering	土木和电气工程
nanoscience [ˈneinəusaiəns] *n.*	纳米科学
nanotechnology [neinəuˌtekˈnɔlədʒi] *n.*	纳米技术
forensic [fəˈrensik] *adj.*	用于法庭的；法医的
bond [bɔnd] *n.*	键
mining [ˈmainiŋ] *n.*	采矿(业)
thermodynamic [ˈθəːməudaiˈnæmik] *adj.*	热力学的
biomaterial [baiəuməˈtiəriəl] *n.*	生物材料
thermodynamics [ˈθəːməudaiˈnæmiks] *n.*	热力学
crystalline [ˈkristəlain] *adj.*	水晶(般)的
crystalline material	晶体材料
amorphous [əˈmɔːfəs] *adj.*	无定形的;非晶态的
polymer [ˈpɔlimə] *n.*	聚合物(体)
ionic [aiˈɔnik] *adj.*	离子的
crystal [ˈkristl] *n.*	水晶
ionic crystal	离子晶体
covalent [kəuˈveilənt] *adj.*	共价

covalent crystal	共价晶体
semiconductor [ˌsemikən'dʌktə] *n.*	半导体
composite ['kɔmpəzit] *adj.*	复合的
composite material	复合材料
vitreous ['vitriəs] *adj.*	玻璃的
vitreous material *n.*	玻璃质材料,玻化材料
quantum ['kwɔntəm] *n.*	量子,量
crystallography [kristə'lɔgrəfi] *n.*	结晶学,晶体学
metallurgy [me'tælədʒi] *n.*	冶金学
tribology [trai'bɔlədʒi] *n.*	摩擦学
catalysis [kə'tælisis] *n.*	催化作用
ceramography [serə'mɔgrəfi] *n.*	陶瓷学
polycrystalline [ˌpɔli'kristəlain] *a.*	多晶的

Notes

1. With significant media attention focused on nanoscience and nanotechnology in recent years, materials science has been propelled to the forefront at many universities.
   近年来,随着媒体对纳米科学和纳米技术的重点关注,材料科学已成为众多大学研究的重点。
2. A major breakthrough in the understanding of materials occurred in the late 19th century, when Willard Gibbs demonstrated that thermodynamic properties relating to atomic structure in various phases are related to the physical properties of a material.
   19 世纪晚期,当威拉德·吉布斯论证了:热力学性能与材料中不同相的原子结构相关,和材料的物理性能相关的理论时,人们对材料的理解发生重大突破。
3. The basis of materials science involves relating the desired properties and relative performance of a material in a certain application to the structure of the atoms and phases in that material through characterization.
   材料科学基础涉及:一定的应用场合下,材料的理想性能和相对性能与材料原子和相的结构特征之间的关系。

Check your understanding

Ⅰ. Give brief answers to the following questions.

1. What is materials science?

Ⅱ. Match the items listed in the following two columns.

civil and electrical engineering	陶瓷学
vitreous material	热力学
nanotechnology	生物材料
ceramography	土木和电气工程
crystallography	晶体学
biomaterial	玻璃质材料
mining	纳米技术
thermodynamics	半导体
semiconductor	聚合物
polymer	采矿

材料科学

材料科学或材料工程是由多学科综合而成的学术领域，它涉及物质的性质及其在各种科学与工程领域的应用。材料科学是研究材料的原子或分子尺度的结构与宏观性能间关系的科学。它包含应用物理及化学的内容，也包括化工、机械、土木和电气工程的知识。近年来，随着媒体对纳米科学和纳米技术的重点关注，材料科学已成为众多大学研究的重点，它也是工程司法鉴定和失效分析的重要组成部分。

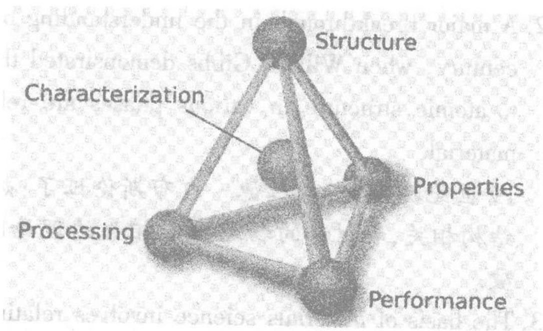

图 1.1-1 材料科学的四面体模型

1. 历史

一定的历史时期，人类使用的材料常常成为时代的标志。石器时代，青铜器时代，钢铁时代就是这样的例子。材料科学起源于制陶业，它是工程学和应用科学最古老的组成部分之一。现代材料科学直接起源于冶金，冶金源于采矿。19世纪晚期，当威拉德·吉布斯论证了：热力学性能与材料中不同相的原子结构相关，和材料的物理性能相关的理论时，人们对材料的理解发生重大突破。太空竞赛的产物成为现代材料科学的重要组成部分，例如，对建造探测太空的航天器的金属合金、硅和碳材料的认识和应用。材料科学带动了塑料、半导体和生物材料等领域的技术革新，也为其所驱动。

因19世纪以来和20世纪初期的研究重点是金属，故在20世纪60年代之前（在某些情况下是几十年后），许多材料科学部门被称为冶金部。以后的研究领域扩展到各种材料，包括：陶瓷、聚合物、半导体、磁性材料、医疗植入材料和生物材料。

2. 材料科学基础

对材料科学的研究，不是为了随意地寻找和发现材料、利用他们的性能，而是以认识材料为目的，以便于创造出性能理想的新材料。

材料科学基础涉及：一定的应用场合下，材料的理想性能和相对性能与材料原子和相的结构特征之间的关系。材料的结构和性能主要取决于组成材料的化学元素和最终原子的排列方式。这些特征通过热力学定律发生相互作用，并共同决定材料的显微组织和性能。

按照自然法则，目前不可能制造出完整的晶体。相反，材料科学家利用晶体材料中的缺陷，如沉淀、晶界（霍尔佩奇关系）、间隙原子、空位或置换原子，来创造性能理想的材料。

并非所有材料都有规则的晶体结构。玻璃、一些陶瓷和许多天然材料是非晶体，它们不含有任何长程有序的原子排列。聚合物具有不同的结晶度，许多聚合物完全是非晶态的。人们在聚合物物理学、聚合物化学和聚合物科学的领域中研究聚合物。

3. 材料分类（按键的类型）

材料科学包括各类材料，每一类材料可能构成一个独立的领域。有时，按原子之间结合键的类型将材料分为：

1）离子晶体
2）共价晶体
3）金属
4）金属间化合物
5）半导体
6）聚合物
7）复合材料
8）玻璃材料

4. 材料科学的分支领域

纳米技术——严格说来，是对具有特性的材料进行研究，这些材料仅在纳米尺度上存在量子局限效应，吉布斯-汤姆逊效应或者其它效应；但更为普遍的是，对结构特征在从不到 1 纳米至 100 纳米尺度范围内的材料进行合成和研究，如分子工程材料学。

微技术——为了对微观结构进行微细加工，研究材料和工艺及其相互关系，如微型机电系统（ MEMS ）。

晶体学——研究原子在固体中的排列，晶体缺陷如晶界和位错，结构特性及其与物理性能的关系。

材料定性分析——如 X 射线衍射分析，电子或中子以及各种形式的光谱学和化学分析，如拉曼光谱、能谱（EDS ）、色谱法、热分析、电子显微镜分析等，目的在于理解和界定材料性能。

冶金学——研究金属及其合金，包括他们的提取，显微组织和工艺。

生物材料——来源于，并和/或和生物系统共同使用的材料。

电磁材料——如用于制造集成电路的半导体，存储介质，传感器和其他装置的材料。

摩擦学——研究由于摩擦和其他因素引起的材料磨损。

表面科学/催化——研究固气、固液或固固界面的相互作用和结构。

陶瓷学 ——研究高温材料和耐火材料的显微组织，包括 RCC 类结构陶瓷、多晶碳化硅和改性增韧陶瓷等。

玻璃材料——包括无机玻璃，玻璃金属和非氧化物玻璃的任何非晶体材料。

法医工程——研究产品如何失效和材料制造过程中的极其重要的因素。

法医材料工程——研究材料的失效，并阐明工程师如何指定他们产品的材料。

Lesson 2 The History of Metallurgy

1 The earliest recorded metal employed by humans appears to be gold which can be found free or "native". Small amounts of natural gold have been found in Spanish caves used during the late Paleolithic period about 40,000 BC.

2 Silver, copper, tin and meteoric iron can also be found native, allowing a limited amount of metalworking in early cultures. Egyptian weapons made from meteoric iron occurred about 3000 B. C.. However, by learning to get copper and tin by heating rocks and combining copper and tin to make an alloy called bronze, the technology of metallurgy began about 3500 B. C. with the Bronze Age.

3 The extraction of iron from its ore into a workable metal is much more difficult. It appears to have been invented by the Hittites in about 1400 B. C., beginning the Iron Age. The secret of extracting and working iron was a key factor in the success of the Philistines.

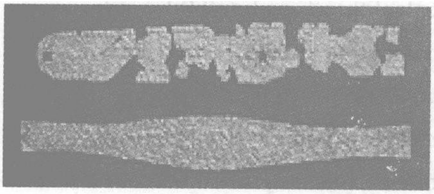

Fig. 1.2 - 1 Gold headband from Thebes 750-700 BC

4 Historical developments in ferrous metallurgy can be found in a wide variety of past cultures and civilizations. This includes the ancient and medieval kingdoms and empires of the Middle East and Near East, ancient Egypt and Anatolia (Turkey), Carthage, the Greeks and Romans of ancient Europe, medieval Europe, ancient and medieval China, ancient and medieval India, ancient and medieval Japan, etc. Of interest to note is that many applications, practices, and devices associated or involved in metallurgy were possibly established in ancient China before Europeans mastered these crafts (such as the innovation of the blast furnace, cast iron, steel, hydraulic-powered trip hammers, etc.).

Fig. 1.2 - 2 Georg Agricola, author of De re metallica, an important early book on metal extraction

5 A 16th century book by Georg Agricola called De re metallica describes the highly developed and complex processes of mining metal ores, metal extraction and metallurgy of the time. Agricola has been described as the "father of metallurgy".

❖ New Words and Phrases

metallurgy [me'tælədʒi] *n.*	冶金；冶金学；冶金术
intermetallic [ˌintə(:)mi'tælik] *adj.*	金属间化合的
compound ['kɔmpaund] *n.*	混合物，化合物
intermetallic compounds	金属间化合物
alloy ['ælɔi] *n.*	合金
craft [krɑ:ft] *n.*	工艺
metalworking ['metəl:ˌwɛ:kiŋ] *n.*	金属加工
paleolithic [ˌpæliəu'liθik] *adj.*	旧石器时代的
paleolithic period	旧石器时代
meteoric [ˌmi:ti'ɔrik] *adj.*	流星的，昙花一现的
meteoric iron	陨铁
bronze [brɔnz] *n.*	青铜
Bronze Age	青铜器时代，青铜时代，铜器时代
ferrous ['ferəs] *a.*	铁的，含铁的
medieval [ˌmedi'i:vəl] *a.*	中古的，中世纪的
blast [blɑ:st] *n.*	爆破，冲击波
furnace ['fə:nis] *n.*	炉子，熔炉
blast furnace	鼓风炉，高炉
hydraulic [hai'drɔ:lik] *a.*	水的，液压的
trip hammer	杵锤
mining ['mainiŋ] *n.*	采矿(业)

❖ Notes

1. The earliest recorded metal employed by humans appears to be gold which can be found free or "native".
   最早记载的人类应用的金属，看起来是无偿获得的或"天然的"黄金。
2. However, by learning to get copper and tin by heating rocks and combining copper