普通高等教育“十一五”国家级规划教材

材料科学与工程专业英语

第二版

匡少平　王世颖　主编

化学工业出版社

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《材料科学与工程专业英语》为普通高等教育“十一五”国家级规划教材，是根据《大学英语教学大纲》专业阅读部分的要求编写的。全书共分七部分，共24个单元，每个单元由一篇课文和一篇阅读材料组成。阅读材料提供与课文相应的背景知识或是课文的续篇；根据课文与阅读材料的内容，配有相应的练习题、注释和词汇表。课文与阅读材料共计48篇，均选自2006～2009年出版的原版英文教科书、科技报告、著作及专业期刊等。其中，第Ⅰ部分为材料科学与工程概论，主要介绍材料科学与工程的历史、材料的分类、材料的特性、材料与化学的关系，以及材料科学的研究进展和发展趋势；第Ⅱ～Ⅶ部分，分别介绍金属材料（包括合金）、陶瓷材料、聚合物材料、复合材料、纳米结构材料和生物医学材料的化学组成、性质、种类、制造技术和用途等。

本教材内容丰富、新颖，知识面宽，趣味性强；适应于各类材料专业的学生使用，也可作为研究生、教师及相关领域研究人员的学习参考书。

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前　言

出版系列的专业英语教材，是许多院校多年来共同的愿望。在高等教育面向21世纪的改革中，学生的基本素质、知识面及实际工作能力的培养受到空前重视，其中专业英语水平是衡量大学生素质能力的重要指标之一。在此背景下，教育部多次组织会议研究加强外语教学问题，制定有关规范，使外语教学更加受到重视。教材是教学的基本要素之一，与基础英语相比，专业英语教学的教材问题显得尤为突出。

国家主管部门的重视和广大院校的呼吁引起了化学工业出版社的关注，他们及时地与原化工部教育主管部门和全国化工类专业教学指导委员会请示协商后，组织全国十余所院校成立了大学英语专业阅读教材编委会。在经过必要的调研后，根据学校需求，编委会优先从各校教学（交流）讲义中确定选题，同时组织力量开展编审工作。本套教材涉及的专业主要包括：化学工程与工艺、石油化工、机械工程、信息工程、工业过程自动化、应用化学、生物工程、环境工程、精细化工及制药工程、材料科学与工程、化工商贸等。

《材料科学与工程专业英语》教材第一版于2003年2月由化学工业出版社出版。2002年9月交稿时，其中包括的课文与阅读材料均选自1999～2002年的原版英文教材、科技报告、著作及专业期刊。现6年多过去了，在材料科学与工程方面出现很多创新理论与技术，因此，有必要将有关新的知识体系对原教材进行更新和完善。2009年6月，该教材第二版被确认为普通高等教育"十一五"国家级规划教材出版。为此，我们吸收第一版时的出版经验，对教材第二版中的内容进行了重新设计，所有课文和阅读材料均选自2006～2009年出版的原版英文教科书、科技报告、著作及专业期刊等，并增加了相关的阅读练习。

教材特点：根据国家"十一五"教材出版规划，按照"全国部分高校化工类及相关专业大学英语专业阅读教材编审委员会"的要求和安排编写的《材料科学与工程专业英语》教材，具有以下特点：(1) 知识面宽：该书囊括了目前与材料科学相关专业的各类知识，金属材料、陶瓷材料、聚合物材料、复合材料、纳米结构材料及生物材料等内容，覆盖范围宽，学科全面；(2) 内容新颖：教材读物均选自国外最新出版的相关学科教材、专著或期刊论文，内容新颖，学科前沿知识丰富，学生和教师都可从中了解材料科学的最新发展趋势；(3) 趣味性强：教材读物在保证学科知识基础性、全面性的前提下，有相当一部分具有很强的趣味性。我们在材料科学类专业英语的教学过程中发现，学生对学科专业以外的知识，如教材中生物材料和纳米材料的功能、应用及其制备表现出极大的兴趣，这样有利于学生拓宽知识面、开阔视野；(4) 读者面宽：《材料科学与工程专业英语》教材适用于各类材料专业的学生使用，也可作为研究生、教师及相关领域研究人员的学习参考书。

内容与结构：教材分为7部分（Part），共24个单元，每个单元由一篇课文和一篇阅读材料组成。阅读材料提供与课文相应的背景知识或是课文的续篇，以进一步拓展课文的内容。根据课文与阅读材料的内容，配有相应的练习题、注释和词汇表。课文与阅读材料共计48篇，其中：Part Ⅰ 为材料科学与工程概论，共6个单元，包括材料科学与工程的历史、材料的分类、材料的特性、材料与化学的关系，以及材料科学的研究进展和发展趋势；Part Ⅱ～Part Ⅶ，分别介绍金属材料（包括合金）、陶瓷材料、聚合物材料、复合材料、纳米结构材料和生物医学材料的化学组成、性质、种类、制造技术和用途等；教材的最后为附录部分，主要包括自然元素（附录1）、与材料科学和工程相关的主要国际学术期刊（附录2）和词汇表。

本教材由匡少平、王世颖主编。其中，Unit 1、4～7、10～12、16～23和Append. 1、2由匡少平同志编写；Unit 3、8、9、13～15、24由王世颖同志编写；Unit 2由匡少平、王

世颖编写；教材最后的阅读理解参考答案（Answer to Reading Comprehension）和词汇表（Glossory）由匡少平同志统一编撰、汇总。全书由匡少平同志统稿。

由于水平所限，教材涉及的内容较广，可能出现错漏，希望广大读者不吝指正，使本书在使用过程中不断改进和完善。

致谢：本教材为普通高等教育“十一五”国家级规划教材。在编写过程中得到化学工业出版社的大力支持，同时得到青岛科技大学教务处、化学与分子工程学院等大力支持。教材中部分阅读材料得到德国 Paderborn 大学 Gregor Fels、Sonja Herres-Pawlis 等教授的大力帮助和指导，他们为我们提供了国际上最新出版的化学类教材；在编写过程中得到陈红、王兰兰、赵辉等同志的大力帮助。在此，谨向他们表示衷心感谢。

编　者

2009 年 6 月

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Part Ⅰ INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING

Unit 1 Materials Science and Engineering

Materials are properly more deep-seated in our culture than most of us realize. Transportation, housing, clothing, communication, recreation and food production—virtually every segment of our everyday lives is influenced to one degree or another by materials. Historically, the development and advancement of societies have been intimately tied to the members' abilities to produce and manipulate materials to fill their needs. In fact, early civilizations have been designated by the level of their materials' development (i. e. Stone Age, Bronze Age).

The earliest humans had access to only a very limited number of materials, those that occured naturally stone, wood, clay, skins, and so on. With time they discovered techniques for producing materials that had properties superior to those of the natural ones: these new materials included pottery and various metals. Furthermore, it was discovered that the properties of a material could be altered by heat treatments and by the addition of other substances. At this point, materials utilization was totally a selection process, that is, deciding from a given, rather limited set of materials the one that was best suited for an application by virtue of its characteristic. It was not until relatively recent times that scientists came to understand the relationships between the structural elements of materials and their properties. This knowledge, acquired in the past 60 years or so, has empowered them to fashion, to a large degree, the characteristics of materials. Thus, tens of thousands of different materials have evolved with rather specialized characteristics that meet the needs of our modern and complex society; these include metals, plastics, glasses, and fibers.

The development of many technologies that make our existence so comfortable has been intimately associated with the accessibility of suitable materials. Advancement in the understanding of a material type is often the forerunner to the stepwise progression of a technology. For example, automobiles would not have been possible without the availability of inexpensive steel or some other comparable substitutes. In our contemporary era, sophisticated electronic devices rely on components that are made from what are called semiconducting materials.

Materials Science and Engineering

Sometimes it is useful to subdivide the discipline of materials science and engineering into materials science and materials engineering subdisciplines. Strictly speaking, "materials science" involves investigating the relationships that exist between the structures and properties of materials. In contrast, "materials engineering" is, on the basis of these structure-property correlations, designing or engineering the structure of a material that produce a predetermined set of properties. From a functional perspective, the role of a materials scientist is to develop or synthesize new materials, whereas a materials engineer is called upon to create new products or systems using existing materials, and/or to develop techniques for processing materials. Most graduates in materials programs are trained to be both materials scientists and materials engineers.

"Structure" is a nebulous term that deserves some explanation. In brief, the structure of a material usually relates to the arrangement of its internal components. Subatomic structure involves electrons within the individual atoms and interactions with their nuclei. On an atomic level, structure encompasses the organization of atoms or molecules relative to one another. The next large structural realm, which contains large groups of atoms that are normally agglomerated together, is termed "microscopic" meaning that which is subject to direct observation using some type of microscope. Finally, structural elements that may be viewed with the naked eye are termed "macroscopic" .

The notion of "property" deserves elaboration. While in service use, all materials are exposed to external stimulin that evoke some type of response. For example, a specimen subject to forces will experience deformation; or a polished metal surface will reflect light. Property is a material trait in terms of the kind and magnitude of response to a specific imposed stimulus. Generally, definitions of properties are made independent of material' shape and size.

Virtually all important properties of solid materials may be grouped into six different categories: mechanical, electrical, thermal, magnetic, optical, and deteriorative. For each, there is a characteristic type of stimulus capable of provoking different responses. Mechanical properties relate deformation to an applied load or force: examples include elastic modulus and strength. For electrical properties, such as electrical conductivity and dielectric constant, the stimulus is an electric filed. The thermal behavior of solids can be represented in terms of heat capacity and thermal conductivity. Magnetic properties demonstrate the response of a material to the application of a magnetic field. For optical properties, the stimulus is electromagnetic or light radiation: index of refraction and reflectivity are representative optical properties. Finally, deteriorative characteristics indicate the chemical reactivity of materials.

In addition to structure and properties, two other important components are involved in the science and engineering of materials, namely "processing" and "performance" . With regard to the relationships of these four components, the structure of a material will depend on how it is processed. Furthermore, a material's performance will be a function of its properties. Thus, the interrelationship between processing, structure, properties, and performance is linear as follows:

Processing→Structure→Properties→Performance

Why Study Materials Science and Engineering?

Why do we study materials? Many an applied scientist or engineer, whether mechanical, civil, chemical, or electrical, will be exposed to a design problem involving materials at one time or another. Examples might include a transmission gear, the superstructure for a building, an oil refinery component, or an integrated circuit chip. Of course, materials scientists and engineers are specialists who are totally involved in the investigation and design of materials.

Many times, a materials problem is to select the right material from many thousands available ones. There are several criteria on which the final decision is normally based. First of all, the in-service conditions must be characterized. On only rare occasion does a material possess the maximum or ideal combination of properties. Thus, it may be necessary to trade off one characteristic for another. The classic example involves strength and ductility; normally, a material having a high strength will have only a limited ductility. In such cases a reasonable compromise between two or more properties may be necessary.

A second selection consideration is any deterioration of material properties that may occur during service operation. For example, significant reductions in mechanical strength may result from exposure to elevated temperatures or corrosive environments.

Finally, probably the overriding consideration is economics. What will the finished product cost? A material may be found that has the ideal set of properties, but is prohibitively expensive. Here again, some compromise is inevitable. The cost of a finished piece also includes any expense incurred during fabrication.

The more familiar an engineer or scientist is with the various characteristics and structure-property relationships, as well as processing techniques of materials, the more proficient and confident he or she will be to make judicious materials choices based on these criteria.

(Selected from William D. Callister, Jr, *Materials Science and Engineering: An Introduction*. 7th ed. John Wiley & Sons, 2007)

New Words and Expressions

pottery *n.* 陶瓷
by virtue of 依靠（……力量），凭借，由于，因为
empower *v.* 授权，准许；使能够
empower sb. to do sth. 授权某人做某事
forerunner *n.* 先驱（者），预兆
stepwise *a.* 逐步地，分阶段地
interdisciplinary *a.* 交叉学科的
metallurgy *n.* 冶金学
nebulous *a.* 星云的，云雾状的，模糊的，朦胧的
agglomerate *n.* 大团，大块；*a.* 成块的，凝聚的
elaboration *n.* 详尽的细节，解释，阐述
electrical conductivity 电导性，电导率
dielectric constant 介电常数
thermal conductivity 热导性，热导率
heat capacity 热容
processing *v.* （材料的）加工，处理
structure *n.* （材料的）结构，构造
property *n.* （材料的）特征，性质
performance *n.* （材料的）性能
refraction *n.* 折射
reflectivity *n.* 反射
strength *n.* 强度
ductility *n.* 延展性
corrosive *a.* 腐蚀的，蚀坏的，腐蚀性的；*n.* 腐蚀物，腐蚀剂
overriding *a.* 最重要的；高于一切的
prohibitive *a.* 禁止的，抑制的
judicious *a.* 明智的
criterion *n.* （pl. criteria）标准，准则，尺度

Notes

① It was not until relatively recent times that scientists came to understand the relationships between the structural elements of materials and their properties. 这是一个强调句，强调时间；came to＋不定式，译为“终于……”，“开始……”。参考译文：直到最近，科学家才终于了解材料的结构要素与其特性之间的关系。

② The notion of “property” deserves elaboration. deserve：应受，值得；elaboration：详尽阐述。参考译文：“property”一词的概念值得详细阐述。

③ The thermal behavior of solids can be represented in terms of heat capacity and thermal conductivity. 句中“represent”的意思是“表现”、“表示”、“描绘”；“term”是指“术语”。参考译文：固体材料的热行为可用热容和热导等术语来描述。

④ In addition to structure and properties，two other important components are involved in the science and engineering of materials，namely “processing” and “performance”. component，原指“组成”、“成分”，该句中指材料科学与工程研究的主要内容；namely，译为“即”。参考译文：除结构与特征外，材料科学与工程还包括另外两项重要的研究内容，即（材料的）加工与性能。

⑤ Many an applied scientist or engineer，. . . ，will at one time or another be exposed to a design problem involving materials. many a（an，another）＋单数名词，许多的，多的，一个接一个的，例如：many a person，许多人；be exposed to：暴露，面临，处于……境地。参考译文：许多应用科学家或工程师，……，在某个时候都将面临涉及材料的设计问题。

⑥ On only rare occasion does a material possess the maximum or ideal combination of properties. 这是一个倒装强调句，其原句为：A material possesses the maximum or ideal combination of properties on only rare occasion. 句中的“on only rare occasion”，可翻译为“只有在极少数情况下”；“possess”是“具有”的意思。

Exercises

1. Question for discussion

(1) What is materials science? What is materials engineering?

(2) What are the main components of materials science and engineering?

(3) Give the important properties of solid materials.

(4) Please elaborate the relationships of processing，structure，properties，and performance.

(5) Why do we study materials science and engineering?

(6) Give some example about the problem of materials science and engineering.

2. Translate the following into Chinese

materials science	Stone Age
naked eye	Bronze age
optical property	integrated circuit
mechanical strength	thermal conductivity

• “Materials science” involves investigating the relationships that exist between the structures and properties of materials. In contrast，“Materials engineering” is，on the basis of these structure-property correlations，designing or engineering the structure of a material to produce a predetermined set of properties.

• Virtually all important properties of solid materials may be grouped into six different categories：mechanical，electrical，thermal，magnetic，optical，and deteriorative.

• In addition to structure and properties，two other important components are involved in the science and engineering of materials，namely “processing” and “performance”.

• The more familiar an engineer or scientist is with the various characteristics and structure-property relationships, as well as processing techniques of materials, the more proficient and confident he or she will be to make judicious materials choices based on these criteria.

• On only rare occasion does a material possess the maximum or ideal combination of properties. Thus, it may be necessary to trade off one characteristic for another.

3. Translate the following into English

交叉学科	介电常数
固体材料	热容
力学性质	电磁辐射
材料加工	弹性系数（模数）

• 直到最近，科学家才终于了解材料的结构要素与其特性之间的关系。
• 材料工程学主要解决材料的制造问题和材料的应用问题。
• 材料的加工过程不但决定了材料的结构，同时决定了材料的特征和性能。
• 材料的力学性能与其所受外力或负荷而导致的变形有关。

4. Reading comprehension

(1) Which material does not occur in nature? ________

(A) pottery (B) wood (C) clay (D) stone

(2) According to the text, all the following statements are true EXCEPT ________.

(A) The earliest humans have access to only a very limited number of materials
(B) The properties of a material could be altered by heat treatments
(C) The properties of a material could be altered by the addition of other substances
(D) The human beings in Bronze Age came to understand the relationships between the structural elements of materials and their properties

(3) In the sentence "The thermal behavior of solids can be represented in terms of heat capacity and thermal conductivity", the word "represented" means ________.

(A) replaced (B) described (C) stood for (D) delegated

(4) According to the author, which of the following properties are important for solid materials? ________

(A) mechanical and deteriorative (B) electric and magnetic
(C) thermal and optical (D) A, B and C

(5) According to the interrelationship of processing, structure, properties, and performance of solid materials indicated in the text, which of the following statements is TRUE? ________

(A) The structure of a solid material depends on its performance.
(B) The processing of a solid material can result in the alteration of its structure, but can not change its properties and performance.
(C) Ultimately, the processing of a solid material determines its structure, properties, and performance.
(D) The properties of a solid material are derived from its performance.

(6) Why do we study materials science and engineering? ________

(A) Because we will be exposed to a design problem involving materials at one time or another.
(B) Because any deterioration of material properties may occur during service operation.
(C) Because the economic consideration for a material is also inevitable.

(D) A, B and C.

Reading Material

The Development of Materials Science

Materials science and 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 scale 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 to 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 forensic materials engineering, the study of failed products and components.

History

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 one. 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 technologies such as plastics, semiconductors, and biomaterials.

Before the 1960s (and in some cases decades after), many *materials science* departments were named *metallurgy* departments, from the 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.

Fundamentals of Materials Science

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

The basis of all 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, taken together and related through the laws of thermodynamics, govern a material's microstructure, and thus its properties.

An old adage in materials science says: "materials are like people; it is the defects that make them interesting". 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.

Not all materials have a regular crystal structure. Polymers display varying degrees of crystallinity, and many are completely non-crystalline. Glasses, some ceramics, and many natural materials are amorphous, not possessing any long-range order in their atomic arrangements. The study of polymers combines elements of chemical and statistical thermodynamics to give thermodynamic, as well as mechanical, descriptions of physical properties.

In addition to industrial interest, materials science has gradually developed into a field which provides tests for condensed matter or solid state theories. New physics emerge because of the diverse new material properties which need to be explained.

Materials in Industry

Radical materials advances can drive the creation of new products or even new industries, but stable industries also employ materials scientists to make incremental improvements and troubleshoot issues with currently used materials. Industrial applications of materials science include materials design, cost-benefit tradeoffs in industrial production of materials, processing techniques (casting, rolling, welding, ion implantation, crystal growth, thin-film deposition, sintering, glassblowing, etc.), and analytical techniques (characterization techniques such as electron microscopy, x-ray diffraction, calorimetry, nuclear microscopy (HEFIB), rutherford backscattering, neutron diffraction, etc.).

Besides material characterization, the material scientist/engineer also deals with the extraction of materials and their conversion into useful forms. Thus ingot casting, foundry techniques, blast furnace extraction, and electrolytic extraction are all part of the required knowledge of a metallurgist/engineer. Often the presence, absence or variation of minute quantities of secondary elements and compounds in a bulk material will have a great impact on the final properties of the materials produced, for instance, steels are classified based on 1/10th and 1/100 weight percentages of the carbon and other alloying elements they contain. Thus, the extraction and purification techniques employed in the extraction of iron in the blast furnace will have an impact of the quality of steel that may be produced.

The overlapping between physics and materials science has led to the offshoot field of *materials physics*, which is concerned with the physical properties of materials. The approach is generally more macroscopic and applied than in condensed matter physics.

The study of metal alloys is a significant part of materials science. Of all the metallic alloys in use today, the alloys of iron (steel, stainless steel, cast iron, tool steel, alloy steels) make up the largest proportion both by quantity and commercial value. Iron alloyed with various proportions of carbon gives low, mid and high carbon steels. For the steels, the hardness and tensile strength of the steel are directly related to the amount of carbon present, with increasing carbon levels also leading to lower ductility and toughness. The addition of silicon and graphitization will produce cast irons (although some cast irons are made precisely with no graphitization). The addition of chromium, nickel and molybdenum to carbon steels (more than 10%) gives us stainless steels.

Other significant metallic alloys are those of aluminium, titanium, copper and magnesium. Copper alloys have been known for a long time (since the Bronze Age), while the alloys of the other three metals have been relatively recently developed. Due to the chemical reactivity of these metals, the electrolytic extraction processes required are only developed relatively recently. The alloys of aluminium, titanium and magnesium are also known and valued for their high strength-to-weight ratios and, in the case of magnesium, their abilities to provide electromagnetic shielding. These materials are ideal for situations where high strength-to-weight ratios are more important than bulk cost, such as in the aerospace industry and certain automotive engineering applications.

Other than metals, polymers and ceramics are also an important part of materials science. Polymers are the raw materials (the resins) used to make what we commonly call plastics. Plastics are really the final product, created after one or more polymers or additives have been added to a resin during processing, which is then shaped into a final form. Polymers which have been around, and which are in current widespread use, include polyethylene, polypropylene, PVC, polystyrene, nylons, polyesters, acrylics, polyurethanes, and polycarbonates. Plastics are generally classified as "commodity", "specialty" and "engineering" plastics.

PVC (polyvinyl-chloride) is widely used, inexpensive, and annual production quantities are large. It lends itself to an incredible array of applications, from artificial leather to electrical insulation and cabling, packaging and containers. Its fabrication and processing are simple and well-established. The versatility of PVC is due to the wide range of plasticisers and other additives that it accepts. The term "additives" in polymer science refers to the chemicals and compounds added to the polymer base to modify its material properties.

Polycarbonate would be normally considered an engineering plastic (other examples include PEEK, ABS). Engineering plastics are valued for their superior strengths and other special material properties. They are usually not used for disposable applications, unlike commodity plastics.

Specialty plastics are materials with unique characteristics, such as ultra-high strength, electrical conductivity, electro-fluorescence, high thermal stability, and so on.

It should be noted here that the dividing line among the various types of plastics is not based on material but rather on their properties and applications. For instance, polyethylene (PE) is a cheap, low friction polymer that commonly used to make disposable shopping bags and trash bags, and is considered a commodity plastic, whereas Medium-Density Polyethylene (MDPE) is used for underground gas and water pipes, and another variety called Ultra-high Molecular Weight Polyethylene (UHMWPE) is an engineering plastic which is used extensively as the glide rails for industrial equipment and the low-friction socket in implanted hip joints.

Another application of material science in industry is the making of composite materials. Composite materials are structured materials composed of two or more macroscopic phases. An example would be steel-reinforced concrete; another can be seen in the "plastic" casings of television sets, cell-phones and so on. These plastic casings are usually a composite material made up of a thermoplastic matrix such as acrylonitrile-butadiene-styrene (ABS) in which calcium carbonate chalk, talc, glass fibres or carbon fibres have been added for added strength, bulk, or electro-static dispersion. These additions may be referred to as reinforcing fibres, or dispersants, depending on their purpose.

(Selected from http://en.wikipedia.org/wiki/Materials_science, 2009)

New Words and Expressions

ceramic *n.* 陶器；*a.* 陶器的

metallurgy *n.* 冶金学

plastic *a.* 塑料的；*n.* 塑料，(外科) 整形的
semiconductor *n.* 半导体
biomaterial *a.* 生物材料的；*n.* 生物材料
polymer *n.* 聚合体，聚合物
implant *v.* & *n.* 深植，嵌入
crystalline *a.* 晶体的，结晶的
thermodynamics *n.* 热力学
foundry *n.* 铸造，铸造场，铸造类
electrolytic *a.* 电解的，由电解产生的
extraction *n.* 抽出，取出，抽出物
purification *n.* 净化，纯化，提纯
chromium *n.* 铬
nickel *n.* 镍
molybdenum *n.* 钼
aluminium *n.* 铝
titanium *n.* 钛
copper *n.* 铜
magnesium *n.* 镁
resin *n.* 树脂（松香，树脂状沉淀物，树脂制品）
additives *n.* 添加剂，助剂
fluorescence *n.* 发荧光，荧光
polyethylene *n.* 聚乙烯
composite *a.* 合成的，复合的；*n.* 合成物，复合材料
calcium carbonate 碳酸钙
glass fibres 玻璃纤维
carbon fibres 碳纤维

Notes

① An old adage in materials science says: "materials are like people; it is the defects that make them interesting". "adage"是指"格言"、"谚语"。"it is the defects that…"，这是一个强调句，意思是"正是材料本身存在的缺陷，……"

② The study of polymers combines elements of chemical and statistical thermodynamics to give thermodynamic, as well as mechanical, descriptions of physical properties. 句中的"elements"是指化学和热力学的"原理"或"基础"。参考译文：通过堆聚合物材料的研究，结合化学和热力学原理，不但可以确定其热力学性质，还可以确定其力学性质，并对其物理特性进行描述。

③ For the steels, the hardness and tensile strength of the steel are directly related to the amount of carbon present, with increasing carbon levels also leading to lower ductility and toughness. "tensile strength"指"拉伸强度"；"carbon levels"是指钢材中的含碳量。参考译文：对钢材而言，其硬度和拉伸强度与钢材中碳含量有着直接的关系，随着含碳量的增加，可导致钢材的延展性和强度降低。

④ Polymers are the raw materials (the resins) used to make what we commonly call plastics. Plastics are really the final product, created after one or more polymers or additives have been added to a resin during processing, which is then shaped into a final form. which is then shaped into a final form，意思是"然后将之加工成最终的形状"。参考译文：聚合物是用来制造我们经常所说的塑料的原材料（树脂）；塑料才是最终产品，它是由一种或多种聚

合物以及助剂加入到一种树脂中，通过加工成型而制造的。

⑤ It should be noted here that the dividing line among the various types of plastics is not based on material but rather on their properties and applications. the dividing line：分界或分界线。参考译文：在这里应该指出的是，不同类型塑料之间的分界不是根据材料本身来确定，而是根据材料的性质和应用来划分的。

⑥ Composite materials are structured materials composed of two or more macroscopic phases. structured material：结构材料；phase：相或相位。参考译文：复合材料是由两个或多个宏观相组成的结构材料。

Reading Comprehension

(1) According to the reading material, which of statements about Willard Gibbs is NOT TRUE? ________

(A) He had great achieve in the late 19th century.

(B) He was the father of materials science and invented many structured materials.

(C) He found that the thermodynamics is related to the physic properties of a material.

(D) He interpreted the thermodynamic properties relating to atomic structure.

(2) The fundamentals of materials science are related to ________ of a material.

(A) the desired properties (B) the relative performance

(C) the perfect structure (D) both A and B

(3) About the crystallinity of materials, all the following statements are false EXCEPT ________.

(A) not all materials have a regular crystal structure

(B) all polymers show the fine crystallinity

(C) all ceramics are not amorphous

(D) most glasses possess long-range order in their atomic arrangements

(4) Industrial applications of materials science include ________ besides materials design.

(A) processing techniques (B) cost-benefit tradeoffs

(C) analytical techniques (D) A, B and C

(5) About the steel, which of the following statements is NOT TRUE? ________

(A) The steel is kind of alloy of iron.

(B) The tensile strength of the steel is directly related to the amount of carbon present.

(C) The ductility of the steel will increase with the increase of the carbon levels.

(D) The toughness of the steel will decrease with the increase of the carbon levels.

(6) According to the passage, the author implies that ________.

(A) with significant media attention to nanoscience and nanotechnology in recent years, materials science has been propelled to the forefront at many universities.

(B) the industrial interests are very important for the development of materials science.

(C) the study of metal alloys is a significant part of materials science.

(D) radical materials advances can drive the creation of new products or even new industries.

Unit 2 Classification of Materials

Classification of Materials

Solid materials have been conveniently grouped into three basic classifications: metals,