石油化工专业英语系列丛书

材料科学与工程

专业英语

石油化工专业英语教材编委会 编

中国石化出版社
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前　言

在经济全球化和高等教育国际化的21世纪，中国高等教育正在与国际接轨，从教育理念、培养目标、育人环境到教材更新和教学方法等方面更加注重学生基本素质、知识结构及实际操作能力的培养，旨在使学生具备较强竞争力和发展潜质，能够在未来的专业领域和职业生涯中迅速适应环境，胜任所从事的工作，成为有所作为的人。专业外语水平是衡量大学生基本素质和综合能力的重要指标之一，在一定程度上决定着学生未来的学术潜力和工作能力。在实际教学过程中，我们发现目前适合工科大学专业外语教学需求的教材比较匮乏。我们应邀编写本系列专业外语教程，就是为了满足工科大学学生和相应读者群的迫切需求。

本套专业外语系列教程包括《材料科学与工程专业英语》《仪表自动化专业英语》《环境科学与工程专业英语》《石油加工专业英语》《过程装备与控制工程专业英语》五部教材。每部教材由30个单元组成，每单元包括课文、词汇表、注释、阅读材料及其注释。课文与阅读材料均选自原版外语教科书、学术报告、专业著作及学术期刊等，语言标准，文体规范，学术性强，难易适度，具有较高的可读性和实用性。

大学本科生在经历基础阶段外语学习之后，通过阅读本教材，能够初步接触本专业领域的基础外语词汇、专业术语和表达方式，领略专业外语的文体和风格，提高专业外语阅读理解能力，为将来直接阅读专业外语文献、进行专业外语写作和学术交流打下良好基础，从而使自己的专业外语水平取得实质性跃进。我们希望本系列教程会对有志于相关专业领域学术研究与发展的学生和读者提供有益的帮助和参考。

为了使这套系列专业外语教程取得理想的教学效果，编者建议选用本教程的学生课前务必认真预习，课堂上教师可组织学生采用介绍、讲述、问答、讨论、归纳等方式，创造积极活跃的课堂气氛，使学生能够得到充分的实践机会，以期达到熟练掌握之目的，尽量避免把专业外语课上成枯燥乏味的翻译课。

《材料科学与工程专业英语》是为材料科学与工程专业三、四年级本科生编写的专业英语教材。本书内容包括材料科学与工程领域的专业基础知识和科技文献，旨在丰富学生专业英语知识广度和深度，开拓学生视野。本书选材严谨，内容新颖，适用面宽，针对性强，可以作为热处理、锻造、焊接等领域的专业英语教材，也可以作为机械类工程技术人员的备用参考书。

本系列教程由辽宁石油化工大学外国语学院英语教师和相关专业英语教师共同编撰。由于时间仓促、水平有限，编写过程中难免出现纰漏，欢迎广大读者在使用过程中不吝赐教，在此深表谢意。由于课文选材比较广泛，故未能一一注明出处，在此一并向原作者表示感谢。

本书编写人员

梁建民　秦　华　刘晓亮　李　楠　夏　丽　马　颖

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Unit 1

Text

Materials Science and Engineering

Historical Perspective

Materials are probably 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.[1] Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fill their needs.[2] 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 occur naturally: stone, wood, clay, skins, and so on.[3] 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.[4] 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 characteristics.[5] It was not until relatively recent times that scientists came to understand the relationships between the structural elements of materials and their properties.[6] This knowledge acquired in the past 60 years or so, has empowered them to fashion, to a large degree, the characteristics of materials.[7] 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 comfortablehas been intimately associated with the accessibility of suitable materials. An advancement in the understanding of a material type is often the forerunner to the stepwise progression of a technology.[8] For example, automobiles would not have been possible without the availability of inexpensive steel or some other comparable substitute. In our contemporary era, sophisticated electronic devices rely on components that are made from what are called semiconducting materials.

Materials Science and Engineering

The discipline of materials science involves investigating the relationships that exist between the structures and properties of materials.[9] 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. Throughout this text we draw attention to the relationships between material properties and structural elements.

"Structure"is at this point 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 larger 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. ⑩ 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 stimuli that evoke some type of response. For example, a specimen subjected 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. ⑫ Generally, definitions of properties are made independent of material shape and size.

Virtually all important properties of solid materials may be grouped into sixdifferent 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 field. 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 areinvolved in the science and engineering of materials, viz. "processing"and"performance."With regard to the relationships of these four components, the structure of a material will depend on how it is processed. ⑬ Furthermore, a materiel's performance will be a function of its properties. Thus, the interrelationship between processing, structure, properties, and performance is linear. Throughout this text we draw attention to the relationships among these four components in terms of the design, production, and utilization of materials.

Why Study Materials Science and Engineering?

Why do we study materials? Many an applied scientist or engineer, whether mechanical, civil, chemical, or electrical, will at one time or another be exposed to a design problem involving materials. 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 one of selecting the right material from the many thousands that are available. There are several criteria on which the finaldecision is normally based. First of all, the in—service conditions must be characterized, for these will dictate the properties required of the material. On only rare occasions does a material possess the maximum or ideal combination of properties. [14] Thus, it may be necessary to trade off one characteristic for another. [15] 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 inmechanical strength may result from exposure to elevated temperatures or corrosive environments.

Finally, probably the overriding consideration is that of 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 to produce the desired shape. [16]

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.

Classification of Materials

Solid materials have been conveniently grouped into three basic classifications: metals, ceramics, and polymers. This scheme is based primarily on chemical makeup and atomic structure, and most materials fall into one distinct grouping or another, although there are some intermediates. In addition, there are three other groups of important engineering materials—composites, semiconductors, and biomaterials. Composites consist of combinations of two or more different materials, whereas semiconductors are utilized because of their unusual electrical characteristics; biomaterials are implanted into the human body. A brief explanation of the material types and representative characteristics is offered next.

METALS

Metallic materials are normally combinations of metallic elements. They have largenumbers of non—localized electrons; that is, these electrons are not bound to particular atoms. Many properties of metals are directly attributable to these electrons. Metals are extremely good conductors of electricity and heat and are not transparent to visible light; a polished metal surface has a lustrous appearance. Furthermore, metals are quite strong, yet deformable, which accounts for their extensive use in structural applications. [17]

CERAMICS

Ceramics are compounds between metallic and nonmetallic elements; they are mostfrequently oxides, nitrides, and carbides. The wide range of materials that falls within this classification includes ceramics that are composed of clay minerals, cement, and glass. These materials are typically insulative to the passage of electricity and heat, and are more resistant to high temperatures and harsh environments than metals and polymers. With regard to me-

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chanical behavior, ceramics are hard but very brittle.

POLYMERS

Polymers include the familiar plastic and rubber materials. Many of them are organic-compounds that are chemically based on carbon, hydrogen, and other nonmetallic elements; furthermore, they have very large molecular structures. These materials typically have low densities and may be extremely flexible.

COMPOSITES

A number of composite materials have been engineered that consist of more thanone material type. Fiberglass is a familiar example, in which glass fibers are embedded within a polymeric material. A composite is designed to display a combination of the best characteristics of each of the component materials. Fiberglass acquires strength from the glass and flexibility from the polymer. Many of the recent material developments have involved composite materials.

SEMICONDUCTORS

Semiconductors have electrical properties that are intermediate between the electrical conductors and insulators. Furthermore, the electrical characteristics of these materials are extremely sensitive to the presence of minute concentrations of impurity atoms, which concentrations may be controlled over very small spatial regions. The semiconductors have made possible the advent of integrated circuitry that has totally revolutionized the electronics and computer industries(not to mention our lives)over the past two decades. [13]

BIOMATERIALS

Biomaterials are employed in components implanted into the human body for replacement of diseased or damaged body parts. These materials must not produce toxic substances and must be compatible with body tissues(i. e. must not cause adverse biological reactions). All of the above materials— metals, ceramics, polymers, composites, and semiconductors — may be used as biomaterials.

Advanced Materials

Materials that are utilized in high — technology (or high — tech) applications are sometimes termed advanced materials. By high technology we mean a device or product that operates or functions using relatively intricate and sophisticated principles; examples include electronic equipment (VCRs, CD players, etc.), computers, fiber optic systems, spacecraft, aircraft, and military rocketry. These advanced materials are typically either traditional materials whose properties have been enhanced or newly developed, high—performance materials. Furthermore, they may be of all material types(e. g. metals, ceramics, polymers), and are normally relatively expensive.

Modern Materials' Needs

In spite of the tremendous progress that has been made in the discipline of materials-science and engineering within the past few years, there still remain technological challenges, including the development of even more sophisticated and specialized materials, as well as consideration of the environmental impact of materials production. Some comment is appropriate relative to these issues so as to round out this perspective.[19]

Nuclear energy holds some promise, but the solutions to the many problems that remain will necessarily involve materials, from fuels to containment structures to facilities for the disposal of radioactive waste.

Significant quantities of energy are involved in transportation. Reducing the weight of transportation vehicles(automobiles, aircraft, trains, etc.), as well as increasing engine operating temperatures, will enhance fuel efficiency. New high—strength, low—density structural materials remain to be developed, as well as materials that have higher—temperature capabilities, for use in engine components.

Furthermore, there is a recognized need to find new, economical sources of energy, and to use the present resources more efficiently. Materials will undoubtedly play a significant role in these developments. For example, the direct conversion of solar into electrical energy has been demonstrated. Solar cells employ some rather complex and expensive materials. To ensure a viable technology, materials that are highly efficient in this conversion process yet less costly must be developed.

Furthermore, environmental quality depends on our ability to control air andwater pollution. Pollution control techniques employ various materials. In addition, materials processing and refinement methods need to be improved so that they produce less environmental degradation, that is, less pollution and less despoilage of the landscape from the mining of raw materials. Also, in some materials manufacturing processes, toxic substances are produced, and the ecological impact of their disposal must be considered.

Many materials that we use are derived from resources that are nonrenewable, that is, not capable of being regenerated. These include polymers, for which the prime raw material is oil, and some metals. These nonrenewable resources are gradually becoming depleted, which necessitates: 1)the discovery of additional reserves, 2)the development of new materials having comparable properties with less adverse environmental impact, and/or 3)increased recycling efforts and thedevelopment of new recycling technologies. As a consequence of the economics of not only production but also environmental impact and ecological factors, it is becoming increasingly important to consider the"cradle-to-grave"life cycle of materials relative to the overall manufacturing process.[20]

New Words and Expressins

1. **deep-seated**/di:p si:tid/*adj*. 根深蒂固的，深层的
2. **virtually**/ˈvɜ:tjuəli/*adv*. 事实上，实质上
3. **advancement**/ ədˈvɑ:nsmənt/*n*. 前进，进步
4. **access**/ˈækses/*n*. 通路，访问，入门；*vt*. 存取，接近
5. **clay**/klei/*n*. 粘土，似黏土的东西
6. **property**/ ˈprɔpəti/*n*. 财产，所有物，所有权，特性
7. **superior**/ sju:ˈpiəriə/*n*. 长者，上级；*adj*. 较高的，上级的
8. **alter**/ˈɔ:ltə/*v*. 改变
9. **suit**/sju:t/*v*. 适合，相配；*n*. 一套衣服

10. **empower**/im'pauə/*v*. 授权与，使能够
11. **fashion**/'fæʃən/*n*. 流行，风尚；*vt*. 形成，使适应，改变
12. **evolve**/ i'vɔlv /*v*. （使）发展，（使）进展，（使）进化
13. **fiber**/'faibə/*n*. = fibre 光纤
14. **intimately**/'intimitli/*adv*. 密切地
15. **stepwise**/'stepwaiz/*adj*. 楼梯式的，逐步的；*n*. 阶式，步进式
16. **progression**/prə'greʃən/*n*. 行进，级数
17. **availability**/ə,veilə'biliti/*n*. 可用性，有效性，实用性
18. **comparable**/'kɔmpərəbl/*adj*. 可比较的，比得上的
19. **contemporary**/kən'tempərəri/*n*. 同时代的人；*adj*. 当代的
20. **era**/'iərə/*n*. 时代，纪元，时期
21. **sophisticated**/ sə'fistikeitid/*adj*. 精密的，久经世故的
22. **electronic**/ilek'trɔnik/ *adj*. 电子的
23. **device**/di'vais/*n*. 装置，设计，设备
24. **semiconducting**/ ,semikən'dʌktiŋ, ,semai-/ *adj*. 半导体的,有半导体特性的
25. **discipline**/'disiplin/*n*. 纪律，学科；*v*. 训练
26. **correlation**/,kɔri'leiʃən/*n*. 相互关系，相关(性)
27. **predetermine**/ 'pri:di'tə:min/*v*. 预定，预先确定
28. **nebulous**/ 'nebjuləs/*adj*. 星云的，模糊的，朦胧的
29. **deserve**/di'zə:v/*vt*. 应受，值得；*v*. 应受
30. **internal**/in'tə:nl/*adj*. 内在的，国内的
31. **subatomic**/'sʌbə'tɔmik/*adj*. 亚原子的
32. **nuclei**/'nju:kliai/*n*. nucleus 的复数形
33. **encompass**/in'kʌmpəs/*v*. 包围,包含
34. **molecule**/ 'mɔlikju:l, 'məu-/*n*. [化]分子，些微
35. **realm**/relm/*n*. 领域
36. **agglomerate**/ ə'glɔməreit/*n*. 大团；*adj*. 凝聚的；*vt*. / *vi*.（使）成团，成块
37. **naked**/'neikid/*adj*. 无遮盖的，无装饰的，无保护的
38. **notion**/nəuʃən/*n*. 概念，观念，想法，主张
39. **elaboration**/ i,læbə'reiʃən/*n*. 苦心经营，详尽叙述
40. **evoke**/i'vəuk/*vt*. 唤起，引起
41. **trait**/treit/*n*. 显著特点，特性
42. **magnitude**/'mægnitju:d/*n*. 数量，巨大
43. **impose**/ im'pəuz/*vt*. 征税，强加；*vi*. 利用，影响
44. **group**/gru:p/*n*. 组，群,批；*v*. 聚合，成群
45. **category**/'kætigəri/*n*. 种类
46. **provoke**/prə'vəuk/*vt*. 激怒，煽动，惹起，驱使
47. **load**/ləud/*n*. 负荷,装载量，工作量；*vt*. 装载；装货,装料
48. **modulus**/'mɔdjuləs/ *n*. 系数，模数
49. **dielectric constant** 介电常数，电容率
50. **electromagnetic**/ilektrəu'mægnitik/*adj*. 电磁的
51. **index**/ 'indeks/*n*. 索引，指数，指标，指针；*vt*. 编入索引
52. **refraction**/ri'frækʃən/*n*. 折光，折射
53. **reflectivity**/,ri:flek'tiviti/*n*. 反射率
54. **viz**/viz./ <拉> 即，就是(读做 namely)
55. **linear**/'liniə/*adj*. 线的，直线的，线性的
56. **civil**/'sivl/*adj*. 民间的,民事的，民用的
57. **transmission**/ trænz'miʃən/*n*. 发射，传输，转播
58. **superstructure**/ 'sju:pə,strʌktʃə/*n*. 上部构造，上层建筑,超结构
59. **refinery**/ri'fainəri/*n*. 精炼厂,炼油厂
60. **integrated circuit** 集成电路
61. **dictate**/dik'teit/*v*. 口授，指令，规定；
62. **trade off** *v*. 交替换位，交替使用;卖掉
63. **ductility**/dʌk'tiliti/*n*. 展延性，柔软性，韧性
64. **elevated**/'eliveitid/*adj*. 提高的，欢欣

65. **corrosive**/ kəˈrəusiv/ *adj*. 腐蚀性的；*n*. 腐蚀剂

66. **overriding**/ˈəuvə ˈraidiŋ/*adj*. 最重要的；高于一切的

67. **prohibitively**/prəˈhibitivli, prəu-/*adv*. 禁止地，抑制地

68. **expense**/ ikˈspens/*n*. 费用，代价，损失，开支

69. **incur**/ inˈkə:/*v*. 招致

70. **fabrication**/ˌfæbriˈkeiʃən/*n*. 制作，构成，伪造物

71. **judicious**/dʒu(:)ˈdiʃəs/*adj*. 明智的

72. **ceramics**/siˈræmiks/*n*. 制陶术，制陶业，陶瓷

73. **scheme**/ ski:m/*n*. 安排，配置，计划，阴谋，方案

74. **primarily**/ˈpraimərili/ *adv*. 首先，起初，主要地，根本上

75. **intermediate**/ˌintəˈmi:djət/*adj*. 中间的；*n*. 媒介

76. **composite**/ˈkɔmpəzit, -zait/*adj*. 合成的；*n*. 合成物

77. **implant**/imˈplɑ:nt/*v*. 灌输，移植，植入

78. **metallic**/mi ˈtælik/*adj*. 金属(性)的/

79. **nonlocalized electron** 非局限电子

80. **lustrous**/ˈlʌstrəs/*adj*. 有光泽的，光辉的

81. **account for** *v*. 说明，占去，解决

82. **oxide**/ˈɔksaid/*n*. [化]氧化物

83. **carbide**/ˈkɑ:baid/*n*. [化]碳化物

84. **insulative**/ ˈinsjuleitiv; ˈinsə-/*adj*. 绝缘的，隔音的

85. **brittle**/ˈbritl/*adj*. 易碎的，脆弱的

86. **density**/ˈdensiti/*n*. 密度

87. **flexible**/ˈfleksəbl/*adj*. 柔韧性，易曲的，灵活的

88. **fiberglass**/ˈfaibəglɑ:s/*n*. 玻璃纤维，玻璃丝

89. **embed**/imˈbed/*vt*. 使插入，嵌入

90. **sensitive**/ ˈsensitiv/*adj*. 敏感的，灵敏的，感光的

91. **presence**/ˈprezns/*n*. 出席，到场，存在

92. **minute**/maiˈnju:t/*adj*. 微小的，详细的

93. **impurity**/imˈpjuəriti/*n*. 杂质，不洁，不纯

94. **spatial**/ˈspeiʃəl/*adj*. 空间的

95. **revolutionize**/ˌrevəˈl(j)u:ʃənaiz/*vt*. 宣传革命，大事改革

96. **toxic**/ˈtɔksik/*adj*. 有毒的，中毒的

97. **adverse**/əˈædvə:s/*adj*. 不利的，敌对的，相反的

98. **round out**/raund aut/ 使成圆形，使饱满，圆满完成，结束

99. **promise**/ˈprɔmis/*vt*. /*n*. 允诺，答应

100. **containment**/ kənˈteinmənt/*n*. 保护外壳，反应堆安全壳

101. **recognize**/ˈrekəgnaizd/*adj*. 公认的，经过验证的

102. **conversion**/kənˈvə:ʃən/*n*. 变换，转化

103. **solar cell** *n*. 太阳能电池

104. **viable**/ ˈvaiəbl/*adj*. 能养活的，能生育的，可行的

105. **despoilage**/disˈpɔilidʒ/*vt*. 夺取，掠夺

106. **ecological**/ˌekəˈlɔdʒikəl/*adj*. 生态学的

107. **resource**/riˈsɔ:s/*n*. 资源，财力，智谋

108. **regenerate**/ riˈdʒenərit/*vt*. 使新生，革新；*vi*. 新生，再生；*adj*. 新生的

109. **deplete**/diˈpli:t/*vt*. 耗尽，使衰竭

110. **cradle-to-grave**/ ˈkreidl təˈ greiv/*adj*. 一辈子的，一生

Notes

1. Transportation, housing, clothing, communication, recreation, and food production — virtually every segment of our everyday lives is influenced to one degree or another by materials.

运输、住房、服装、交通、娱乐及食品生产 —— 我们日常生活的方方面面几乎都在不同程度上受到材料的影响。

virtually *adv.* 实际上，几乎 He's become ~ bankrupt. 他实际上已经破产。

2. Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fill their needs.

从历史看，社会的发展和进步与其成员生产并使用材料以满足其需求的能力密切相关。

intimately *adv.* 密切，紧密

3. The earliest humans had access to only a very limited number of materials, those that occur naturally: stone, wood, clay, skins, and so on.

早期人类仅能利用到非常有限的几种材料，这些都是天然材料，如石头、木材、陶土、皮革等。

have access to 拿得到，使用，见得到

those 在此为 materials 的同位语。

4. 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.

随著时间的推移，人们发现了生产特性优于天然材料的技术，这些新材料包括陶器和各种金属。

with time 渐渐地，慢慢地

superior to 优于，比……强

5. 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 characteristics.

在这一点上，材料利用全然是一个选择过程，即从既有的有限材料中选择，依据材料特点进行优选。

given *adj.* 规定的，一定的，指定的

the one 在此为其前 a selection process 的同位语。

6. It was not until relatively recent times that scientists came to understand the relationships between the structural elements of materials and their properties.

直到近代，科学家们才开始了解材料的结构成分与其特性的关系。

recent times 近代

come to *v.* 开始干……

It was... that 是英语中常见的强调结构，其中"…"为被强调部分，that 一般不可用其他词替换。

7. This knowledge acquired in the past 60 years or so, has empowered them to fashion, to a large degree, the characteristics of materials.

近 60 来年所取得的这一知识已经使科学家们能够在很大程度上塑造材料的特点。

(which has been) acquired in the past 60 years or so 做定语。

empower sb to do sth 相当于 enable sb to do sth，意为"使具有干某事的能力"。

to a large degree 为插入语，表示"在很大程度上"。

8. An advancement in the understanding of a material type is often the forerunner to the stepwise progression of a technology.

对于材料类型方面的进一步认识往往是一种技术阶梯式发展的预兆。

stepwise *adj*. 楼梯式的，逐步的；*n*. 阶进式

progression *n*. 前进，进展，级数

9. The discipline of materials science involves investigating the relationships that exist between the structures and properties of materials.

材料科学学科研究材料结构与特性之间所存在的关系。

10. On an atomic level, structure encompasses the organization of atoms or molecules relative to one another.

在原子层面上，结构包括原子或分子相互间的组织形式。

Relative to 与……有关的，涉及，相对于；e. g. the position of the sun ～ the earth 太阳与地球的相对位置。

11. The next larger 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.

下一级更大的结构领域被称为"微观"，意指需要用显微镜才能直接观察的范围，包括大批通常凝聚在一起的原子团。

which 引起非限制性定语从句，修饰 structural realm；meaning 引起的现在分词短语作状语。

be subject to 1. 易受…… 的 e. g. be subject to fits of passion 动辄发怒 2. 须经…… 的，将会……的 e. g. The treaty is subject to ratification. 本条约须经批准方可生效。

12. Property is a material trait in terms of the kind and magnitude of response to a specific imposed stimulus.

特性是材料特点，即材料对于外来具体刺激的反应种类及程度大小。

13. With regard to the relationships of these four components, the structure of a material will depend on how it is processed.

至于这四者间的关系，材料结构会依据加工方式而定。

in/with regard to 关于，至于 laws in regard to human rights 关于人权的法律

14. On only rare occasions does a material possess the maximum or ideal combination of properties.

只有在极少数情况下材料才会有最佳或理想的综合性能。

15. Thus, it may be necessary to trade off one characteristic for another.

因此有必要以一种特点替代另一种。

Trade off... for/against 换掉，以……作物物交换，互相轮流

e. g. trade off inflation against unemployment 在通胀和失业之间进行协调

16. The cost of a finished piece also includes any expense incurred during fabrication to produce the desired shape.

制成品的成本也包括制造所要求产品的所有费用。

incur *v*. 由……引起，遭受 e. g. ～ a heavy loss 招致重大损失

17. Furthermore, metals are quite strong, yet deformable, which accounts for their extensive use in structural applications.

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