深圳大学
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专业英语
English in Materials Science and Engineering

材料学院

教学目标

- 掌握材料科学与工程的专业英语词汇
- 掌握专业英语阅读和翻译能力
- 了解英语科技论文的写作格式和要求

考核方式

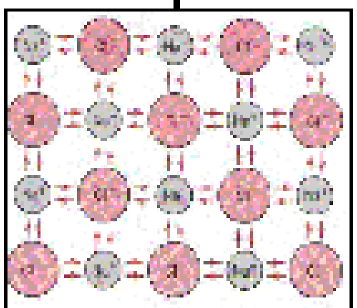
- 平时成绩：出勤情况、课堂提问；30%
- 期末成绩：开卷考试；70%

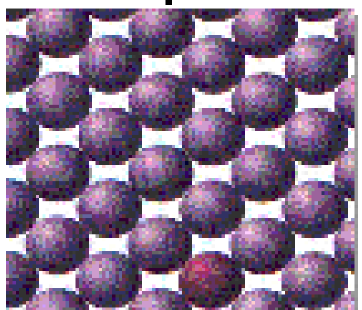
What is Materials Science and Materials Engineering?

- Materials science is the investigation of the relationship among processing (工艺), structure (结构), properties (特性), and performance (使用效能) of materials. The discipline of 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.

- 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*** (领域), 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***".

亚原子结构 → 晶体结构 → 显微镜下的结构 → 肉眼下的结构





亚原子结构	晶体结构	显微镜下的结构	肉眼下的结构
电子在原子中运动的特征	原子的排列方式：晶体或非晶体	显微镜下观察到的结构称为显微组织	称为宏观组织

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- Property is a material trait (特性) in terms of the kind and magnitude of response to a specific imposed stimulus （刺激）. 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（退化的）. For each there is a characteristic type of stimulus capable of provoking （诱导） different responses.

- In addition to structure and properties, two other important components are involved in the science and engineering of materials. They are “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.

Classification of materials

METALS

Metallic materials are normally combinations of metallic elements. They have large numbers of nonlocalized 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.

Classification of materials

CERAMICS

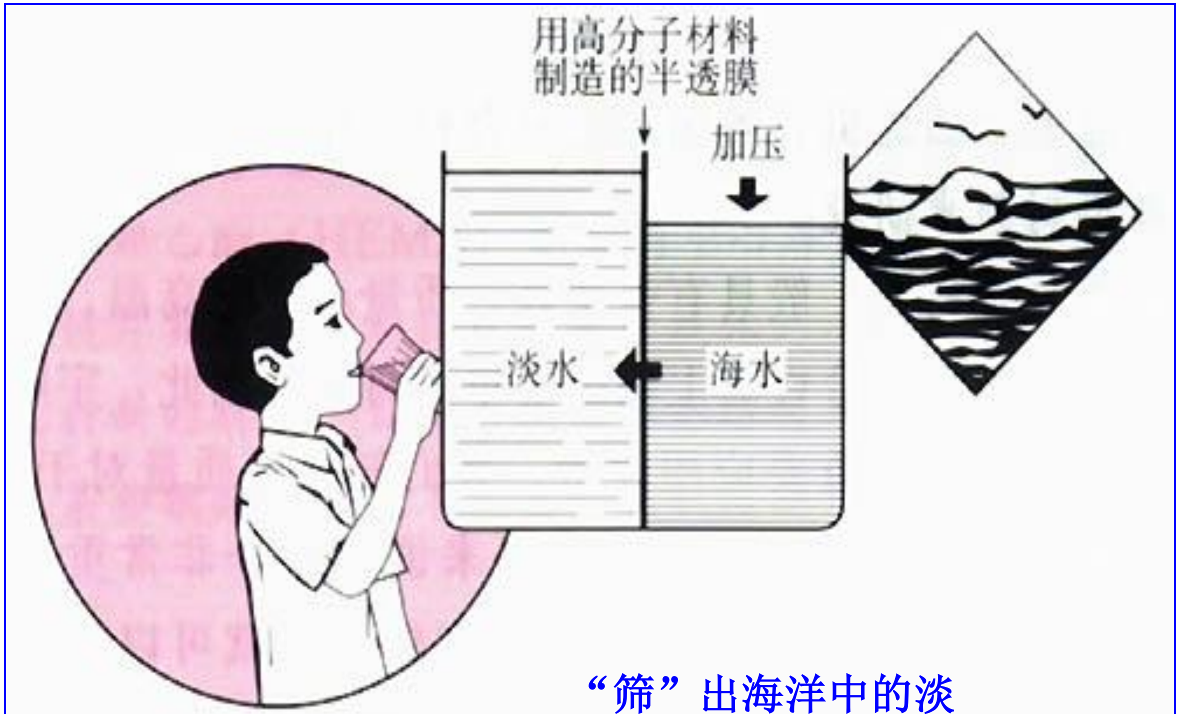
Ceramics are compounds between metallic and nonmetallic elements; they are most frequently oxides, nitrides, and carbides. The wide range of materials that falls within this classification includes ceramics that are composed of clay minerals, cement（水泥）, and glass. These materials are typically insulative to the passage of electricity and heat, and are more resistant to high temperatures and harsh environments than metals and polymers. With regard to mechanical behavior, ceramics are hard but very brittle.

Classification of materials

POLYMERS

Polymers include the familiar plastic and rubber（橡胶） 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.

采用高分子分离膜材料制备半透膜，
可以让海水经过滤后可以直接饮用。



“筛”出海洋中的淡水 ！

Classification of materials

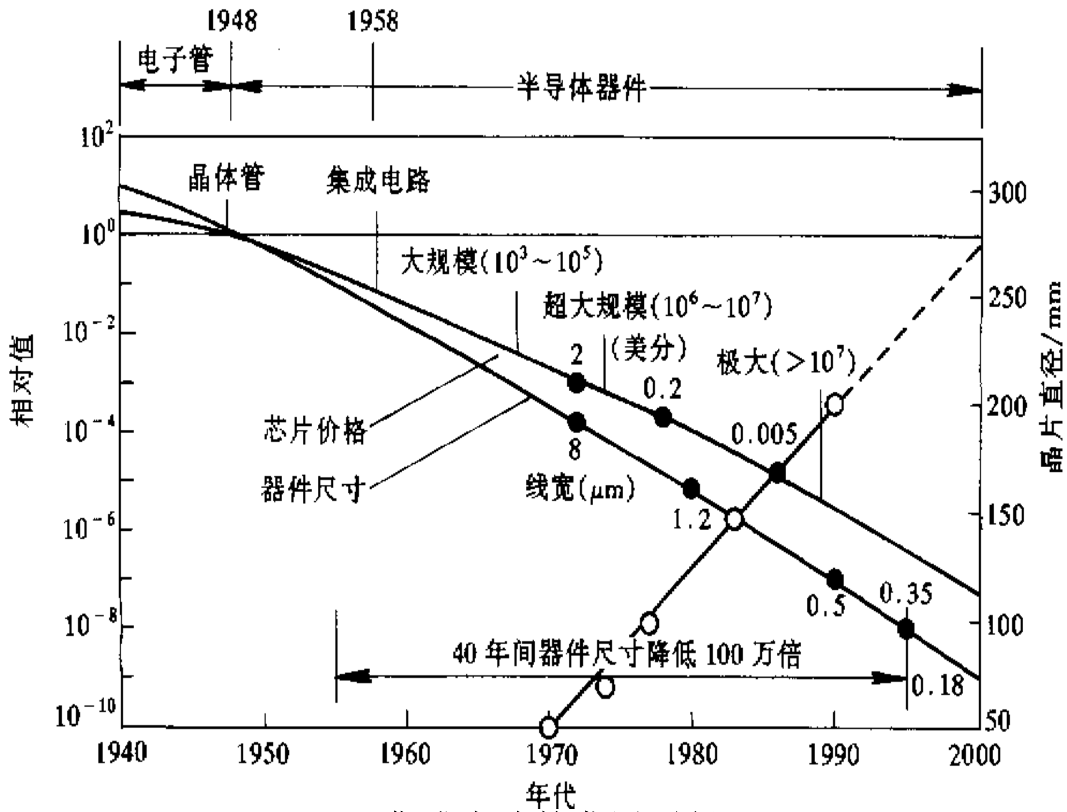
COMPOSITES

A number of composite materials have been engineered that consist of more than one 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.

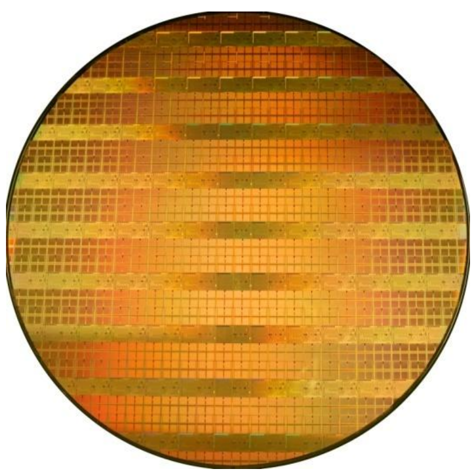
F-22是美国战斗机中使用钛合金与复合材料最多的机型。其中钛合金约36％、复合材料约25％ 。F-22机身蒙皮全部采用高强度、耐高温的BMI复合材料。

New types of materials

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; these concentrations may be controlled over very small spatial regions. The semiconductors have made possible the advent of integrated circuit that has totally revolutionized the electronics and computer industries over the past two decades.



集成电路的发展历程



带有45 nm 测试芯片的 Intel® 300 mm晶圆. 下一代英特尔45 nm双核处理器“Penryn”拥有4亿1000万晶体管，这意味着在一根头发丝的直径方向上可以放上2000个45 nm的晶体管。

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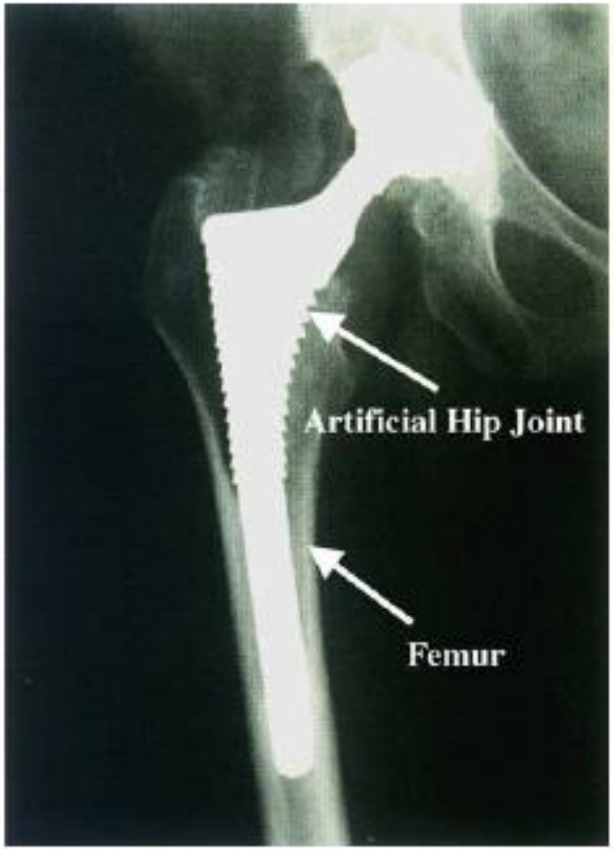
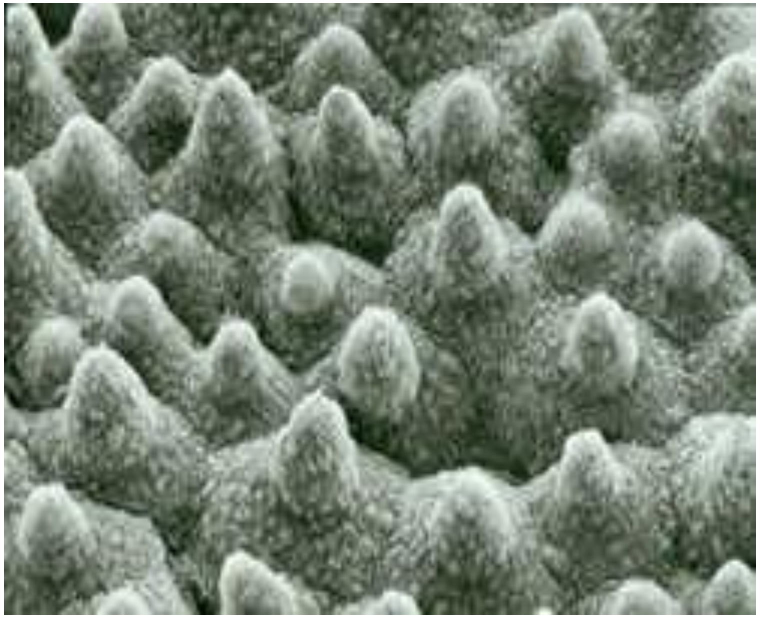
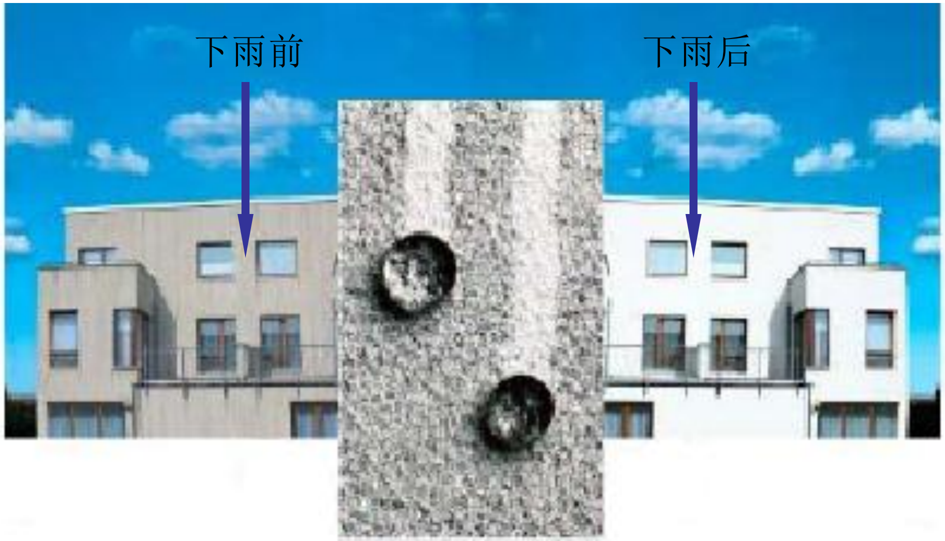
New types of materials

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. All of the above materials-metals, ceramics, polymers, composites, and semiconductors-may be used as biomaterials. For example, some of the biomaterials are utilized in artificial hip（髋） replacements.



人工髋关节示意图，用到金属，高分子和陶瓷材料

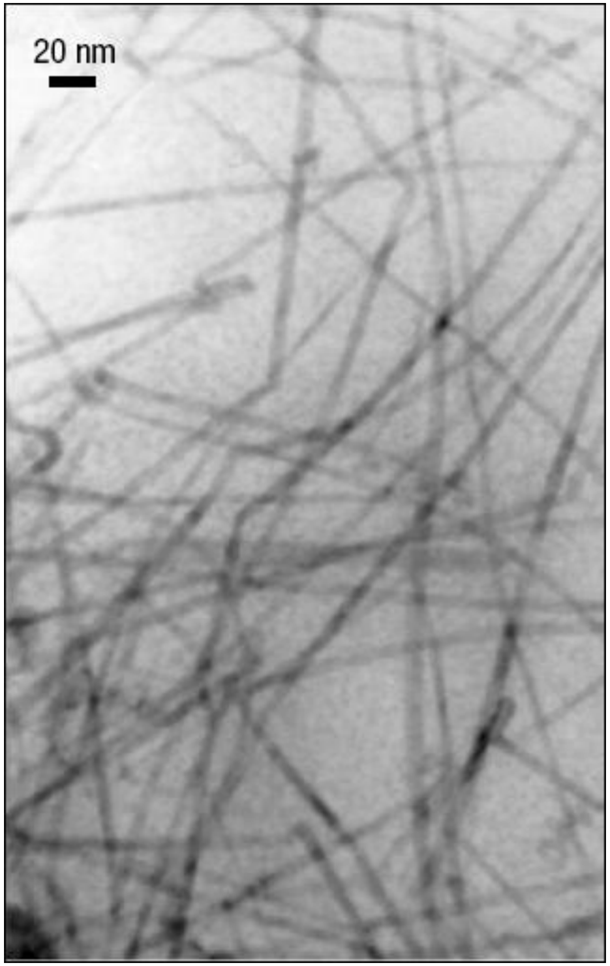


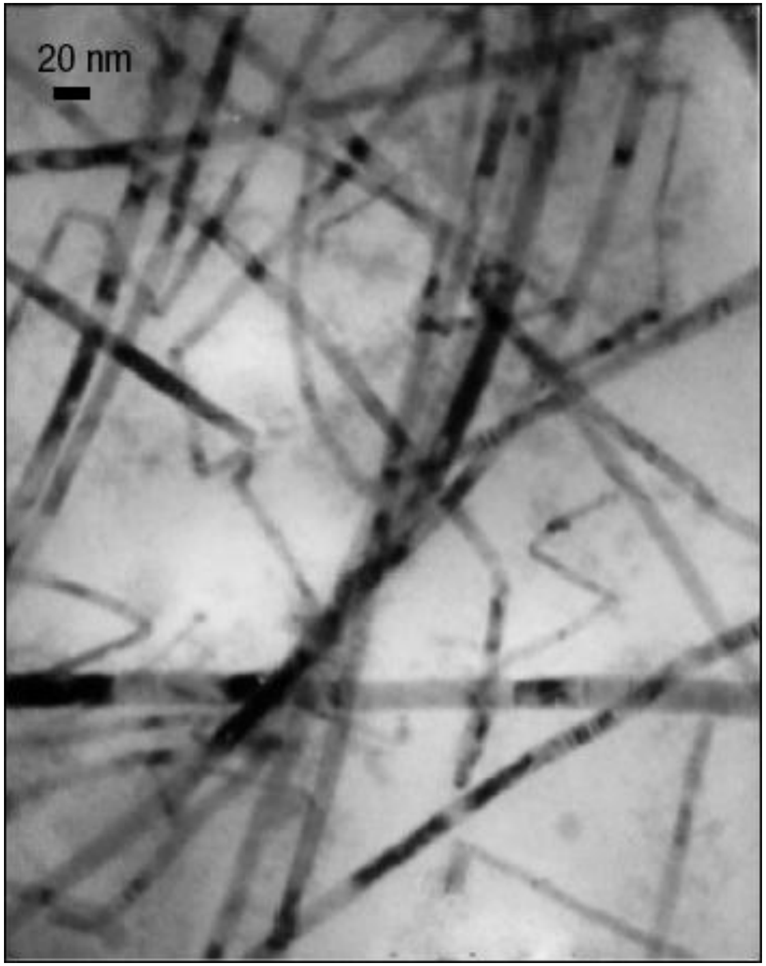


通过模仿莲花叶面的显微结构，可以制备出防水自洁的涂料

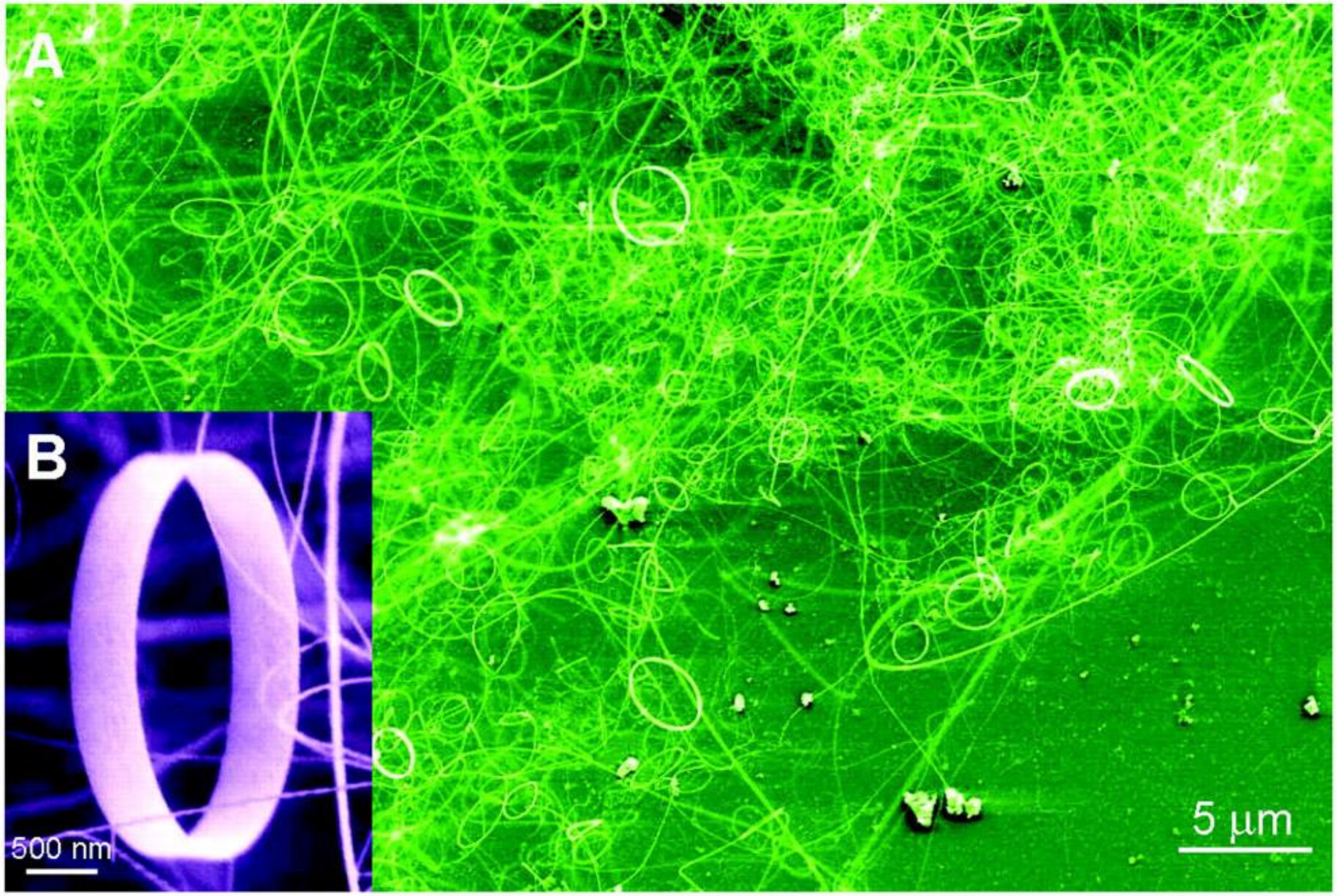
Nanomaterials and Nanotechnology

With the advent of scanning probe microscopes, which permit observation of individual atoms and molecules to form new structures and, thus, design new materials that are built from simple atomic level constituents. This ability to carefully arrange atoms provides opportunities to develop mechanical, electrical, magnetic, and other properties that are not otherwise possible. The study of the properties of these materials is termed “nanotechnology”; the “nano” prefix denotes that the dimensions of these structural entities are on the order of a nanometer (10^{-9}). In the future we will undoubtedly find that increasingly more of our technological advance will utilize these nanoengineered materials.





通过Solution-liquid-solid法制备出的InP量子线的透射电子显微照片(Nature Materials 2003, Vol.2)。平均直径: (a) 4.49±0.75nm; (b) 11.01±2.29nm.



ZnO纳米线与纳米环

文体与翻译

文体

- 口语体
- 文艺体
- 新闻体
- 科技文章

口语体

“ It appears that you've got the offer of a very good job.”

“A wonderful job.”

“are you going to take it”

“I don't think so.”

“Why not?”

“I don't want to.”

The Razor's Edge

“听说有个很好的工作要你去做。”

“挺好的工作。”

“打算干吗？”

“不。”

“为什么不干？”

“不想干。”

摘自《刀锋》

口语体特点

用词自由，句法简单，短句与省略句多，自然朴素，生活气息浓。翻译时常省去主语。

文艺体

She was of a helpless, fleshy build, with a frank, open countenance and an innocent, diffident manner. Her eyes were large and patient, and in them dwelt such a shadow of distress as only those who have looked sympathetically into the countenances of the distraught and helpless poor know anything about.

Jennie Gerhardt

那夫人生着一副绵软多肉的体格，一张坦率开诚的面容，一种天真羞怯的神气，一双大落落的柔顺眼睛，里边藏着无穷的心事，只有那些对于凄惶无告的穷苦人面目作过同情观察的人才看得出来。

摘自《珍妮姑娘》（傅东华译）

文艺体特点

形象生动，修辞富于艺术色彩，大量使用形容词。

新闻体

MONTREAL- Clark Johns accomplished a spectacular debut for this NHL career tonight, the first score launching a four-point first period outburst, to lead the Johnson City High Hats to a 6-4 victory over the Montreal Teals and their eight consecutive game without a loss.

［蒙特利尔电］在全国手球联赛中克拉克·约翰斯今晚初试锋芒，引起轰动。上半场先领先四分，首开纪录。克拉克发挥中坚作用，约翰逊市高帽队终以6:4击败蒙特利尔市小鸭队，创造了连胜八场未负一场的战绩。

新闻体特点

简明扼要，短小精悍，结构紧凑，笔锋犀利。

科技文章

The range of a voltmeter may be extended by means of a series resistor called a multiplier as shown in Fig. 2. The fullscale reading of the meter alone may be 15 volts. With the multiplier 150 volts may be required to move the pointer to full-scale, 135 volts across the multiplier and 15 volts across the meter.

如图2所示，采用一种称为倍增电阻的串联电阻器即可扩大伏特表的量程。量表单独使用时的满刻度读数可以为15伏。倘有倍增电阻，指针偏转到满刻度的读数可达150伏；其中倍增电阻两端之间的读数为135伏，表头内的读数为15伏。

科技文章的特点

科技文体崇尚严谨周密，概念准确，逻辑性强，行文简练，重点突出，句式严整，少有变化，常用前置性陈述，即句子中将主要信息尽量前置，通过主语传递主要信息。

科技文章的特点是：清晰、准确、精炼、严密。在语法上有下列特点：

1. 大量使用名词化结构；
2. 广泛使用被动语态；
3. 大量使用后置定语；
4. 存在一些特定句型；
5. 往往出现许多长句；
6. 大量使用复合词和缩略词

一、大量使用名词化结构

- 大量使用名词化结构（Nominalization）是科技英语的特点之一，这是因为科技文体要求行文简洁、表达客观、内容确切、信息量大；强调存在的事实，而非某一行为。

一、大量使用名词化结构

- 例1: Archimedes first discovered the principle that water is displaced by solid bodies.

  Archimedes first discovered the principle *of displacement of water by solid bodies*.

- 例2: The earth rotates on its own axis, which causes the change from day to night

  The *rotation of the earth* on its own axis causes the change from day to night.

一、大量使用名词化结构

- 例3: If you use firebricks round the walls of the boiler, the heat loss can be considerably reduced.

  The heat loss can be considerably reduced *by the use of firebricks round the walls of the boiler.*

- 例4: Television transmits and receives images of moving objects by radio waves (无线电波).

  Television is *the transmission and reception of images of moving objects by radio waves.*

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二、广泛使用被动化语态

- 科技英语中的谓语至少三分之一是被动态，这是因为科技文章侧重叙事推理，强调客观准确。第一、二人称使用过多，会造成主观臆断的印象，因此尽量使用第三人称叙述，采用被动语态。
- 如前所述，科技文章将主要信息前置，放在主要部分，也是广泛使用被动态的主要原因。

二、广泛使用被动化语态

- 例1: You must pay attention to the working temperature of the machine.×
- Attention must be paid to the working temperature of the machine.

二、广泛使用被动化语态

- *We* can store electrical energy in two metal plates separated by an insulating medium. *We* call such a device a capacitor, or a condenser, and its ability to store electrical energy capacitance. *We* measure capacitance in farads. ×
- *Electrical energy* can be stored in two metal plates separated by an insulating medium. *Such a device* is called a capacitor, or a condenser, and *its ability to store electrical energy* is termed capacitance. *It* is measured in farads.

三、大量使用非限定动词

- 科技英语要求行文简练，结构紧凑，为此往往使用分词短语代替定语从句或状语从句；使用分词独立结构代替状语从句或并列结构；使用不定式短语代替各种从句；介词＋动名词短语代替定语从句或状语从句。这样可缩短句子，比较醒目。

三、大量使用非限定动词

- 例1: A direct current is a current *which flows always in the same direction.*

A direct current is a current *flowing always in the same direction.*

- 例2: Heat causes air currents to rise *when it is radiating from the earth.*

Radiating from the earth, heat causes air currents to rise .

三、大量使用非限定动词

- 例3: Vibrating objects produce sound waves *and each vibration produces one sound wave.*

  Vibrating objects produce sound waves, *each vibration producing one sound wave.*

- 例4: In communications, the problem of electronics is *how information is conveyed from one place to another.*

  In communications, the problem of electronics is *how to convey information from one place to another.*

三、大量使用非限定动词

- 例5: Materials *which are used for structural purposes* are chosen *so that they behave elastically in the environmental conditions.*

  Materials *to be used for structural purposes* are chosen *so as to behave elastically in the environmental conditions.*

- 例6: There are different ways *in which we can change energy from one form into another.*

  There are different ways *of changing energy from one form into another.*

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三、大量使用非限定动词

- 例7：*When the radio waves are made to correspond to each sound in turn*, messages are carried from a broadcasting station to a receiving set.

In making the radio waves correspond to each sound in turn, messages are carried from a broadcasting station to a receiving set.

四、大量使用后置定语

大量使用后置定语也是科技文章的特点之一，常见的结构有五种：

1.介词短语

2.形容词及形容词短语

3.副词

4.单个分词，但仍保持较强的动词意义

5.定语从句

四、大量使用后置定语

1. 介词短语:

- 例1: The forces *due to friction* are called frictional forces.
- 例2: A call *for paper* is now being issued.

四、大量使用后置定语

2. 形容词及形容词短语:

- 例1: In this factory the only fuel *available* is coal.
- 例2: In radiation, thermal energy is transformed into radiant energy, *similar in nature to light*.

四、大量使用后置定语

3. 副词:

- 例1: The air outside pressed the side *in.*
- 例2: The force upward equals the force *downward* so that the balloon stays at the level.

四、大量使用后置定语

4. 保持较强的动词意义的单个分词:

- 例1: The results *obtained* must be checked.
- 例2: The heat *produced* is equal to the electrical energy wasted.

四、大量使用后置定语

5. 定语从句:

- 例1： During construction, problems often arise *which require design changes.*
- 例2: The molecules exert forces upon each other, *which depend upon the distance between them.*
- 例3: Very wonderful changes in matter take place before our eyes every day *to which we pay little attention.*
- 例4: To make an atomic bomb we have to use uranium 235, *in which all the atoms are available for fission.*

科技文章的特点

6. 特定句型

科技文章中经常使用若干特定句型，从而形成科技文体区别与其他文体的标志。例如：

- It…that …结构句型
- 被动语态句型
- as结构句型
- 分词短语结构句型
- 省略句结构句型

常用句型

被动语态句型:

- 例1: Computers *may be classified* as analog and digital.
- 例2: The switching time of the new-type transistor *is shortened* three times.
- 例3: This steel alloy *is believed to be the best available there.*

常用句型

as结构句型:

- 例1: Electromagnetic waves travel *at the same speed as* light.
- 例2: Microcomputers are very small in size, *as shown in Fig. 5.*
- 例3: In water sound travels nearly *five times as fast as* in air.

常用句型

分词短语句型:

- 例1: *Compared with hydrogen*, oxygen is nearly 16 times as heavy.
- 例2: *The resistance being very high*, the current in the circuit was low.
- 例3: Ice keeps the same temperature *while melting*.

常用句型

省略句构句型:

- 例1: An object, *once in motion*, will keep on moving because of its inertia.
- 例2: All substances, *whether gaseous, liquid or solid*, are made of atoms.

科技文章的特点

7. 大量使用复合词与缩略词

- 是科技英语的另一个特点，复合词从过去的双词组合发展到多词组合；缩略词是趋向于任意构词。

复合词与缩略词

- Full-enclosed 全封闭的
- Self-regulating device 自动调节装置
- Metal-to –metal contact 金属与金属的接触
- Pollution control equipment 污染控制设备
- Work-harden 加工硬化
- Criss-cross 交叉着
- On-and-off-the-road 路面越野两用的
- Anti-armoured-fighting-vehicle-missile 反装甲车导弹
- Radiophotography 无线电传真
- Colorimeter色度计

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复合词与缩略词

- ft (foot/feet) 英尺
- cpd (compound) 化合物
- FM (frequency modulation) 调频
- P.S.I. (pounds per square inch) 磅 / 英寸^2
- SCR (silicon controlled rectifier) 可控硅整流器
- TELESAT (telecommunications satellite) 通信卫星

Ferrous alloys

More than 90% by weight of the metallic materials used by human beings are *ferrous alloys*. This represents an immense family of *engineering materials* with a wide range of microstructures and related properties. *The majority of* engineering designs that require *structural load* support or *power transmission* involve ferrous alloys. As a practical matter, these alloys *fall into* two broad categories *based on* the carbon in the alloy composition.

Steel generally contains between *w_c*=0.05% and w_c=2%. The cast ions generally contain between w_c=2% and w_c=4.5%. Within the steel category, we shall distinguish whether or not a significant amount of *alloying elements other than* carbon is used. A composition of 5% total noncarbon additions will *serve as* an arbitrary boundary between low alloy and high alloy steels. These alloy additions are chosen carefully because they i*nvariably* bring with them sharply increased material costs. They are *justified* only by the essential improvements in properties such as higher strength or improved *corrosion resistance*.

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Questions:

1) How do you distinguish steel from cast iron?

2) How do you distinguish low alloy steel from high alloy steel?

翻译练习

人们于40多年前开发出非晶合金并把其用作磁芯或其他材料的增强体。因为非晶合金的厚度仅为几十个微米，其应用范围受到限制。在过去的二十年中，日本和美国的非晶研究小组所开创的研究成果已经极大地提高了非晶的尺寸。一些非晶合金具有高达3000 MPa的抗拉强度，还有优异的抗腐蚀性能，较好的韧性，低的内耗和良好的加工性能。大块非晶合金已用于家用电器和体育用品等行业。

- 人们于40多年前开发出非晶合金并把其用作磁芯或其他材料的增强体。

People invented amorphous alloy…

People developed amorphous alloy…

Amorphous alloys were developed over 40 years ago and found applications as magnetic core or reinforcement added to other materials.

- 因为非晶合金的厚度仅为几十个微米，其应用范围受到限制。

A few microns

Dozens of micrometer

The scope of applications is limited due to the small thickness in the region of only tens of micronmeters.

- 在过去的二十年中，日本和美国的非晶研究小组所开创的研究成果已经极大地提高了非晶的尺寸。

During the passive of 20 years

In the last 20 years

In the passed 20 years

The research effort in the past two decades, mainly pioneered by a Japanese- and a US-group of scientists, has substantially relaxed the size constrain.

- 一些非晶合金具有高达3000MPa的抗拉强度，还有优异的抗腐蚀性能，较好的韧性，低的内耗和良好的加工性能。

Some bulk metallic glasses can have tensile strength up to 3000 MPa with good corrosion resistance, reasonable toughness, low internal friction and good processability

- 大块非晶合金已用于家用电器和体育用品等行业。

Bulk metallic glasses are now being used in consumer electronic industries, sporting goods industries, etc.

Glass Ceramics

Among the most sophisticated ceramic materials are the *glass ceramics*. As the name implies, they combine the nature of crystalline ceramics with glass. The result is a product with especially attractive qualities. Glass ceramics begin as relatively ordinary glassware. A significant advantage is their ability to be formed into a product shape economically and precisely.

By a carefully controlled heat treatment, over 90% of the material crystallizes. The final crystalline grain sizes are generally between 0.1 and 1 μm. The small amount of residual glass phase effectively fills the grain boundary volume, creating *a pore free structure*. The final glass ceramic product *is characterized by* mechanical and thermal shock resistance far *superior to* conventional ceramics. The sensitivity of ceramic materials to brittle failure will be discussed later.

The resistance of glass ceramics to mechanical shock is largely due to the elimination of stress concentrating pores. The resistance to thermal shock results from characteristically low *thermal expansion coefficients* of these materials.

We have *alluded to* the importance of a carefully controlled heat treatment to produce the uniformly fine grained microstructure of a glass ceramic. The theory of heat treatment (the kinetics of solid state reactions) was dealt with in other passage.

For now, we need to recall that the crystallization of a glass is a stabilizing process. Such a transformation begins at some impurity phase boundary. For an ordinary glass in the molten state, crystallization will tend to nucleate at a few isolated spots along the surface of the melt container. This is followed by the growth of a few, large crystals. The resulting microstructures is "coarse" and non-uniform. Glass ceramics differ by their addition of several weight percent of a *nucleating agent* such as TiO_2. *A fine dispersion of* small TiO_2 particles gives a nuclei density as high as 1012 per cubic millimeter. For a given composition, optimum temperature exist for nucleating and growing the small crystallites.

Cements (水泥)

Several familiar ceramic materials are classified as inorganic cements. cements are produced *in extremely large quantities*. The characteristic feature of these materials is that when mixed with water, they form a paste that subsequently sets and hardens. This trait is especially useful in that solid and rigid structures having just about any shape may be *expeditiously* formed. Also, some of these materials act as a bonding phase that chemically binds *particulate*（微粒的）aggregates into a single cohesive structure.

Under these circumstances, the role of the cement is similar to that of the glassy bonding phase that forms when clay products and some refractory bricks are fired. One important difference, however, is that the *cementitious* 粘性的bond develops at room temperature.

Of this group of materials, *portland cement* is consumed in the largest *tonnage*s. It is produced by grinding and intimately mixing clay and *lime*-bearing minerals in the proper proportions, and then heating the mixture to about 1400℃ in a rotary *kiln*; this process, sometimes called *calcination*, produces physical and chemical changes in the raw materials. The resulting "*clinker*" product is then ground into a very fine powder to which is added a small amount of *gypsum* to retard the setting process. This product is portland cement. The properties of portland cement, including setting time and final strength, to a large degree depend on its composition.

Portand cement is termed a *hydraulic cement* because its hardness develops by chemical reactions with water. It is used primarily in *mortar* and *concrete* to bind, into a cohesive mass, aggregates of inert particles; these are considered to be composite materials. Other cement materials, such as lime, are *nonhydraulic*; that is, compounds other than water (e.g., CO_2) are involved in the hardening reaction.

Several different constituents are found in portland cement, the principal ones being tricalcium silicate($3CaO-SiO_2$) and dicalcium silicate($3CaO-SiO_2$). The setting and hardening of this material result from relatively complicated hydration reactions that occur between the various cement constituents and the water that is added .

These hydrated products are in the form of complex gels or crystalline substances that form the cementitious bond. Hydration reactions begin just as soon as water is added to the cement. These are first manifested as setting (i.e.,the stiffening of the once-plastic paste), which takes place soon after mixing ,usually within several hours. Hardening of the mass follows as a result of further hydration, a relatively slow process that may continue for as long as several years. It should be emphasized that the process by which cement harden is not one of drying but, rather,of hydration in which water actually participates in a chemical bonding reaction.

翻译练习(2)

离子束注入是半导体工业中的一个主要技术。聚焦离子束提供了一种在几十个纳米长度上局部操控器件结构的方法。与其他技术相比，聚焦离子束是注入与光刻的结合。这种优点减少了制造一个特定器件结构所需技术步骤。

聚焦离子束的强大技术潜能激发了科学界研究离子注入所导致的半导体结构变化的极大兴趣。注入的离子与主晶格相互作用，产生大量空位和间隙。这些缺陷造成局部晶格变形并伴随基体材料的化学成份变化。

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Ion beam implantation is one of major technologies in the semiconductor industry. Focused ion beam implantation opens the way to manipulate the device structure locally on a length scale of a few tens of nanometers. Compared to other techniques, focused ion beam combines implantation and optical lithography. This big advantage enables reduction of technological steps necessary to make a particular device structure.

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The high technological potential of FIB generates a great interest of the scientific community to investigate the structural changes of semiconductors induced by ion beam implantation. Implanted ions interact with the host lattice and produce a large number of vacancies and interstitials. These defects cause local lattice deformation accompanied by a change of the chemical composition of the host material.

学术论文的英文写作简介

一、学术论文的结构

- **Title (标题)**
- **Abstract (摘要)**
- **Keywords (关键词)**
- **Introduction (引言)**
- **Experimental details (实验方法)**
- **Results (结果)**
- **Discussion (讨论)**
- **Conclusion (结论)**
- **Acknowledgement (致谢)**
- **References (参考文献)**

学术论文的英文写作简介

二、正文

学术论文的正文一般包括Experimental details，Results，Discussion三个部分。这三部分主要描述研究课题的具体内容、方法，研究过程中所使用的设备、仪器、条件，并如实公布有关数据和研究结果等。Discussion是对全文内容或有关研究课题进行的总体性讨论。它具有严密的科学性和客观性，反映一个研究课题的价值，同时提出以后的研究方向。

为了帮助说明论据、事实，正文中经常使用各种图表。最常用的是附图（Figure）和表（Table），此外还有图解或简图（Diagram）、曲线图或流程图（Graph）、视图（View）、剖面图（Profile）、图案（Pattern）等。在文中提到时，通常的表达法为：

如图 4 所示　As (is) shown in Fig.4,

如表 1 所示　As (is) shown in Table 1,

学术论文的英文写作简介

三、结论

在正文最后应有结论（**Conclusions**）或建议**(Suggestions)**。

(1) 关于结论可用如下表达方式**:**

① **The following conclusions can be drawn from …(**由……可得出如下结论**)**

② **It can be concluded that …(**可以得出结论……**)**

③ **It is generally accepted (believed, held, acknowledged) that…(**一般认为**…)(**用于表示肯定的结论**)**

(2) 关于建议可用如下表达方式。

① **It is advantageous to (do)**

② **It should be realized (emphasized, stressed, noted, pointed out) that …**

③ **It is suggested (proposed, recommended, desirable) that …**

④ **It would be better (helpful, advisable) that…**

学术论文的英文写作简介

四、结尾部分

1、致谢

为了对曾给予支持与帮助或关心的人表示感谢，在论文之后，作者通常对有关人员致以简短的谢词，可用如下方式：

Thanks are given to sb. for sth

The author wishes to express his sincere appreciation to sb. for sth.

The author wishes to acknowledge sb.

The author wishes to express his gratitude for sth.

学术论文的英文写作简介

四、结尾部分

2、参考文献

在论文的最后应将写论文所参考过的主要论著列出，目的是表示对别人成果的尊重或表示本论文的科学根据，同时也便于读者查阅。参考文献的列法如下：

如果是书籍，应依次写出作者、书名、出版社名称、出版年代、页数。如:

Dailey, C.L. and Wood, F.C., Computation curves for compressible Fluid Problems, *John Wiley & Sons, Inc. New York,* 1949, pp.37-39

如果是论文，应依次写出作者、论文题目、杂志名称、卷次、期次、页数。如：

Marrish Joseph G.,Turbulence Modeling for Computational Aerodynamics, *AIAA J.Vol-21,No.7*, 1983, PP.941-955

如果是会议的会刊或论文集，则应指出会议举行的时间、地点。如：

Proceedings of the Sixth International Conference on Fracture Dec.4-10,1984, New Delhi, India

如果作者不止一人，可列出第一作者，其后加上**et al**。如：**Wagner, R.S. et al, ….**

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科技论文标题的写法

学术文章的标题主要有三种结构：名词性词组(包括动名词)，介词词组，名词词组+介词词组。间或也用一个疑问句作标题(多用在人文社会科学领域)，但一般不用陈述句或动词词组作标题。

一、名词性词组 (noun phrase/ gerundial phrase)

名词性词组由名词及其修饰语构成。名词的修饰语可以是形容词、介词短语，有时也可以是另一个名词。名词修饰名词时，往往可以缩短标题的长度。以下各标题分别由两个名词词组构成。例如：

Latent demand and the browsing shopper (名词词组+名词词组)

Cost and productivity (名词+名词)

科技论文标题的写法

二、介词词组 (prepositional phrase)

介词词组由介词十名词或名词词组构成。如果整个标题就是一个介词词组的话，一般这个介词是“on”，意思是“对……的研究”。例如：

<u>From Knowledge Engineering</u> to Knowledge Management （介词词组+介词词组)

On the correlation between working memory capacity and performance on intelligence tests

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科技论文标题的写法

三、名词/名词词组+介词词组

这是标题中用得最多的结构。例如：

Simulation of Controlled Financial Statements **(名词+介词词组)**

The impact of internal marketing activities on external marketing outcomes **（名词+介词词组+介词词组）**

Diversity in the Future Work Force **(名词+介词词组)**

Models of Sustaining Human and Natural Development **(名词+介词词组)**

标题中的介词词组一般用来修饰名词或名词词组，从而限定某研究课题的范围。这种结构与中文的“的”字结构相似，区别是中文标题中修饰语在前，中心词在后。英文正好相反，名词在前，而作为修饰语的介词短语在后。例如：

Progress on Fuel Cell and its Materials (燃料电池及其材料进展)

科技论文标题的写法

四、其他形式

对于值得争议的问题，偶尔可用疑问句作为论文的标题，以点明整个论文讨论的焦点。例如：

Is B2B e-commerce ready for prime time?

Can ERP Meet Your eBusiness Needs?

科技论文标题的写法

有的标题由两部分组成，用冒号(：)隔开。一般来说，冒号前面一部分是研究的对象、内容或课题，比较笼统，冒号后面具体说明研究重点或研究方法。这种结构可再分为三种模式。

模式1 研究课题：具体内容。例如：

Microelectronic Assembly and Packaging Technology：Barriers and Needs

The Computer Dictionary Project: an update

模式2 研究课题：方法 / 性质。例如：

B2B E-Commerce: A Quick Introduction

The Use of Technology in Higher Education Programs: a National Survey

模式 3 研究课题：问题焦点。例如：

Caring about connections: gender and computing

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英文摘要的写作技巧

英文摘要(Abstract)的写作应用很广。论文摘要是全文的精华，是对一项科学研究工作的总结，对研究目的、方法和研究结果的概括。

一、摘要的种类与特点

摘要主要有以下四种。

第一种是随同论文一起在学术刊物上发表的摘要。这种摘要置于主体部分之前，目的是让读者首先了解一下论文的内容，以便决定是否阅读全文。一般来说，这种摘要在全文完成之后写。字数限制在100～150字之间。内容包括研究目的、研究方法、研究结果和主要结论。

第二种是学术会议论文摘要。会议论文摘要往往在会议召开之前几个月撰写，目的是交给会议论文评审委员会评阅，从而决定是否能够录用。所以，比第一种略为详细，长度在200—300字之间。会议论文摘要的开头有必要简单介绍一下研究课题的意义、目的、宗旨等。如果在写摘要时，研究工作尚未完成，全部研究结果还未得到，那么，应在方法、目的、宗旨、假设等方面多花笔墨。

英文摘要的写作技巧

第三种为学位论文摘要。学士、硕士和博士论文摘要一般都要求用中、英文两种语言写。学位论文摘要一般在400字左右，根据需要可以分为几个段落。内容一般包括研究背景、意义、主旨和目的；基本理论依据，基本假设；研究方法；研究结果；主要创新点；简短讨论。不同级别的学位论文摘要，要突出不同程度的创新之处，指出有何新的观点、见解或解决问题的新方法。

第四种是脱离原文而独立发表的摘要。这种摘要更应该具有独立性、自含性、完整性。读者无需阅读全文，便可以了解全文的主要内容。

英文摘要的写作技巧

二、摘要的内容与结构

摘要内容一般包括：

- 目的(objectives，purposes)：包括研究背景、范围、内容、要解决的问题及解决这一问题的重要性和意义。
- 方法(methods and materials)：包括材料、手段和过程。
- 结果与简短讨论(results and discussions)：包括数据与分析。
- 结论(conclusions)：主要结论，研究的价值和意义等。

概括地说，摘要必须回答“研究什么”、“怎么研究”、“得到了什么结果”、“结果说明了什么”等问题。

无论哪种摘要，语言特点和文体风格也都相同。首先必须符合格式规范。第二，语言必须规范通顺，准确得体，用词要确切、恰如其分，而且要避免非通用的符号、缩略语、生偏词。另外，摘要的语气要客观，不要做出言过其实的结论。

英文摘要的写作技巧

三、学术期刊论文摘要

1、摘要的目的

摘要是论文的梗概，提供论文的实质性内容的知识。摘要的目的在于：给读者关于文献内容的足够的信息，使读者决定是否要获得论文。

2、摘要的要素

1） 目的——研究、研制、调查等的前提、目的和任务，所涉及的主题范围。

2） 方法——所用的原理、理论、条件、对象、材料、工艺、结构、手段、装备、程序等。

3） 结果——实验的、研究的结果、数据，被确定的关系，观察结果，得到的效果、性能等。

4） 结论——结果的分析、研究、比较、评价、应用，提出的问题等。

3、摘要的篇幅

摘要的篇幅取决于论文的类型。但无论哪一种论文，都不能超过**150 words**。

英文摘要的写作技巧

4、摘要的英文写作风格(公认的英文摘要写作规范)

1） 句子完整、清晰、简洁。

2） 用简单句。为避免单调，改变句子的长度和句子的结构。

3） 用过去时态描述作者的工作，因它是过去所做的。但是，用现在时态描述所做的结论。

4） 避免使用动词的名词形式。如：

正： “Thickness of plastic sheet was measured”

误： “measurement of thickness of plastic sheet was made”

5） 正确地使用冠词，既应避免多加冠词，也应避免蹩脚地省略冠词。如：

正： “Pressure is a function of the temperature”

误： “The pressure is a function of the temperature”;

英文摘要的写作技巧

4、摘要的英文写作风格

6） 使用短的、简单的、具体的、熟悉的词。不使用华丽的词藻。

7） 使用主动语态而不使用被动语态。“A exceeds B”读起来要好于“B is exceeded by A”。使用主动语态还有助于避免过多地使用类似于“is”，“was”，“are”和“were”这样的弱动词。

Abstract writing

Ⅰ. Requirement: Sentences → Correct in grammar

Ⅱ. How to make sentences standard to natives

1. Passive voice (被动语态)

I, you ×

"人们" "大家" { one √ / people ×

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eg. ①本文提出/介绍/讨论 …… ……

√ √ ***(Passive)*** ***Something is presented/ proposed/ introduced / proved (in this paper)***

√ ***This paper presents … …***

× ***I present … in this paper.***

② 这是一个人们感兴趣的问题

③ "我" "我们" —> **the author(s)**

2. Tenses

Simple present > simple future & present perfect

> Simple past & present progressive

eg. ①最后作者举例说明了IC的应用。

Finally, the applications of IC are <u>illustrated</u> with examples.

② ……被广泛地应用于……

… has been widely used in …

… has found wide use in …

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3. Idiomatic expressions, set patterns

eg. ① …与 …相吻合

A agrees with B

➔ *A is in good agreement with B*

The results obtained are in good agreement with the calculated values.

② 本文重点讲述了 …

Emphasis is put on …

③ 这是一个与 ··有关的问题

This is a problem { *concerned with / related to* ; *concerning / dealing with* } ……

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4. Vocabulary in paper writing

(1) Tend to use big words instead of common words

approximately	→ *about*
caution	→ *care*
purchase	→ *buy*
utilize / employ	→ *use*
inquire	→ *ask*
commence	→ *begin*
eventually	→ *in the end*
whereby	→ *by which*

（2）Tend to use formal verbs instead of phrasal verbs

maintain → *keep up*

extinguish → *put out*

consume → *use up*

perform → *carry out*

encounter → *come across*

(3) Tend to use pre-modifiers instead of post-modifiers

< compound adjectives >

a U-shaped magnet

a fast-growing industry

a newly-built laboratory

(4) Seldom use short forms of words

(5) Tend to use nouns instead of verbs to express actions

(6) Use a different word from that in the Chinese language in some cases

- **Synthesis of self-assembled nanoscale structures by focused ion-beam induced deposition**

- S.M. Allameh [a], N. Yao [b], W.O. Soboyejo [a,*]

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Received 21 October 2002; received in revised form 12 May 2003; accepted 17 May 2003

- **Abstract**
- **This paper presents the results of recent experiments that lead to the nanofabrication of hollow platinum structures in a focused ion beam microscope. The inclination of the substrate with respect to the ion beam is shown to control the growth direction of Pt on the surface of polysilicon.**

- Keywords: Ion-beam processing; Thin films; Platinum; Nanostructures

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- **Title: Fe-based bulk metallic glasses with diameter thickness larger than one centimeter**
- **Author(s):** Ponnambalam V, Poon SJ, Shiflet GJ
- **Source:** JOURNAL OF MATERIALS RESEARCH 19 (5): 1320-1323 MAY 2004
- **Document Type:** Article
- **Language:** English
- **Cited References:** 12 **Times Cited:** 135
- **Abstract:** Fe-Cr-Mo-(Y,Ln)-C-B bulk metallic glasses (Ln are lanthanides) with maximum diameter thicknesses reaching 12 mm have been obtained by casting. The high glass formability is attained despite a low reduced glass transition temperature of 0.58. The inclusion of Y/Ln is motivated by the idea that elements with large atomic sizes can destabilize the competing crystalline phase, enabling the amorphous phase to be formed. It is found that the role of Y/Ln as a fluxing agent is relatively small in terms of glass formability enhancement. The obtained bulk metallic glasses are non-ferromagnetic and exhibit high elastic moduli of approximately 180-200 GPa and microhardness of approximately 13 GPa.

- **Title: Structural** amorphous **steels Author(s):** Lu ZP, Liu CT, Thompson JR, Porter WD **Source:** PHYSICAL REVIEW LETTERS 92 (24): Art. No. 245503 JUN 18 2004 **Document Type:** Article **Language:** English **Cited References:** 16 **Times Cited:** 127
- **Abstract:** Recent advancement in bulk metallic glasses, whose properties are usually superior to their crystalline counterparts, has stimulated great interest in fabricating bulk amorphous steels. While a great deal of effort has been devoted to this field, the fabrication of structural amorphous steels with large cross sections has remained an alchemist's dream because of the limited glass-forming ability (GFA) of these materials. Here we report the discovery of structural amorphous steels that can be cast into glasses with large cross-section sizes using conventional drop-casting methods. These new steels showed interesting physical, magnetic, and mechanical properties, along with high thermal stability. The underlying mechanisms for the superior GFA of these materials are discussed.

- **Title: Large-scale fabrication of tower-like, flower-like, and tube-like ZnO arrays by a simple chemical solution route Author(s):** Wang Z, Qian XF, Yin J, Zhu ZK **Source:** LANGMUIR 20 (8): 3441-3448 APR 13 2004 **Document Type:** Article **Language:** English **Cited References:** 38 **Times Cited:** 99
- **Abstract:** Large-scale arrayed ZnO crystals with a series of novel morphologies, including tower-like, flower-like, and tube-like samples, have been successfully fabricated by a simple aqueous solution （水溶液）route. The morphology and orientation of the obtained ZnO crystal arrays can be conveniently tailored by changing the reactants and experimental conditions. For example, the tower-like ZnO crystal arrays were obtained in a reaction solution system including zinc salt, ammonia, ammonium salt, and thiourea, and the orientation of these tower-like crystals could be controlled by the contents of these reactants. Flower-like ZnO arrays were obtained at lower temperatures, and tube-like ZnO arrays were obtained by ultrasonic pretreatment of the reaction system. The growth mechanism of the tower-like and tube-like ZnO crystals was investigated by FESEM. The results show that tower-like crystals grow layer by layer, while tube-like crystals grow from active nanowires. Ultrasonic pretreatment is proved to be effective in promoting the formation of active nuclei, which have important effects on the formation of the tube-like ZnO crystals. In addition, large-scale arrays of these ZnO crystals can be successfully synthesized onto various substrates such as amorphous glass, crystalline quartz, and PET. This implies this chemical method has a wide application in the fabrication of nano-/microscale devices.

- **Title: Titanium oxide nanotubes, nanofibers and nanowires**
- **Author(s):** Yuan ZY, Su BL
- **Source:** COLLOIDS AND SURFACES A-PHYSICOCHEMICAL AND ENGINEERING ASPECTS 241 (1-3): 173-183 Sp. Iss. SI, JUL 14 2004
- **Document Type:** Article
- **Language:** English
- **Cited References:** 29   **Times Cited:** 64
- **Abstract:** A simple one-step hydrothermal reaction among TiO2 powders and alkaline solution has been developed to synthesize low-dimensional titanate nanostructures. The morphologies of the obtained nanomaterials depend on the process parameters: the structure of raw material, the nature and concentration of alkaline solution, reaction temperature and time, which suggests that the nanostructure synthesis could be controllable. Trititanate nanotubes with the diameters of about 10 nm were synthesized via the hydrothermal reaction of TiO2 crystals of either anatase （锐钛矿）or rutile （金红石） phase and NaOH solution in the temperature range of 100-160degreesC. Nanotibers with an interlinked structure were formed when amorphous TiO2 or commercial TiOSO4 was treated with NaOH at 100-160degreesC. Pentatitanate nanoribbons with high aspect ratio were obtained by autoclaving of either crystalline or amorphous TiO2 in NaOH solution at the temperature above 180degreesC. Octatitanate nanowires with the diameters of 5-10 nm were prepared from TiO2 particles treated with KOH solution. These nanostructures were analyzed by a range of methods including powder X-ray diffraction (XRD), high resolution transmission electron microscopy (HRTEM), selected area electron diffraction (SAED), energy dispersive X-ray spectroscopy (EDX) and infrared spectroscopy (IR).

Strain-controlled growth of nanowires within thin-film cracks

- There is continued interest in finding quicker and simpler ways to fabricate nanowires, even though research groups have been investigating possibilities for the past decade. There are two reasons for this interest: first,nanowires have unusual properties—for example, they show quantum-mechanical confinement effects, they have a very high surface-to-volume ratio, enabling them to be used as sensors, and they have the ability to connect to individual molecules. Second, no simple method has yet been found to fabricate nanowires over large areas in arbitrary material combinations.Here we describe an approach to the generation of well-defined nanowire network structures on almost any solid material, up to macroscopic sample sizes. We form the nanowires within cracks in a thin film. Such cracks have a number of properties that make them attractive as templates for nanowire formation: they are straight, scalable down to nanometre size, and can be aligned (by using microstructure to give crack alignment via strain).We demonstrate the production of nanowires with diameter <16 nm, both singly and as networks; we have also produced aligned patterns of nanowires, and nanowires with individual contacts.

英文摘要的写作练习

晶态金属的本质塑性或脆性与弹性剪切模量mu和体积模量B的比值有关。当比值mu/B超过某一临界值时，金属是脆性的。有关弹性模量和韧性的足够数据允许对非晶合金的性能进行衡量。我们发现在非晶合金中也存在与金属类似的关系：非晶合金中mu/B 的临界值比金属范围狭窄，介于0.41与0.43之间。这个临界值也适用于退火导致的非晶脆化。机械性能与mu/B之间明确的相互关系有助于理解流动和断裂机理，也有助于指导合金设计以降低非晶合金的脆性。

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- **Title: Intrinsic plasticity or brittleness of metallic glasses**
- **Author(s):** Lewandowski JJ, Wang WH, Greer AL
- **Source:** PHILOSOPHICAL MAGAZINE LETTERS 85 (2): 77-87 FEB 2005
- **Document Type:** Article
- **Language:** English
- **Cited References:** 33 **Times Cited:** 76
- **Abstract:** The intrinsic plasticity or brittleness of crystalline metals correlates with the ratio of the elastic shear modulus mu to the bulk modulus B; when the ratio mu/B exceeds a critical value, the metal is brittle. Sufficient data on elastic moduli and toughness are now available to permit an assessment for metallic glasses. We find a similar correlation, with the critical value of mu/B for metallic glasses (0.41-0.43) more sharply defined than for crystalline metals. This critical value applies also for annealing-induced embrittlement of metallic glasses. The clear correlation between mechanical behaviour (plasticity or brittleness) and mu/B assists in understanding flow and fracture mechanisms, and in guiding alloy design to alleviate brittleness of metallic glasses.

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复　　习

常见金相组织名称

ferrite	铁素体
Austenite	奥氏体
cementite	渗碳体
pearlite	珠光体
martensite	马氏体
troostite	屈氏体
sorbite	索氏体
bainite	贝氏体
ledeburite	莱氏体

常用表示形状的词汇

Dendritic 树枝状的

Filamentary 细丝的

Tubular 管状的

Nodular 球状的

Granular 粒状的

Flaky 片状的

Lamellar 层状的

Acicular 针状的

Fibrillar 纤维状的

Whisker 晶须

常用元素的名称

iron
copper
nickel
lead
zinc

tungsten
molybdenum
magnesium
titanium
calcium

Vanadium 钒

Tin 锡 Sn

Platinum 铂 Pt

Ruthenium 钌

Antimony 锑 Sb

Yttrium 钇

Boron 硼

Nitrogen 氮

Cobalt 钴

Sodium 钠

Sulphur 硫

Phosphorus 磷

Halogen 卤素

Fluorine 氟

Chlorine 氯

Bromine 溴

Iodine 碘

常见化合物名称

Carbide 碳化物
Nitride 氮化物
Chloride 氯化物
Carbonate碳酸盐
Silicate 硅酸盐
Titanate 钛酸盐

Zirconia 氧化锆
Silica 氧化硅
Alumina 氧化铝

常用词缀

hypo-	亚	micro-	微
hyper-	过	macro-	宏观
quasi-	类似,准	Nano-	纳米
Di-	二	piezo-	压电
Tri-	三	hemi-	半
Tetra-	四	Iso-	相等的

其它常用词汇

Ductility 延展性

Viscosity 粘性

Porosity 孔隙

Toughness 韧性

Fatigue 疲劳

Corrosion 腐蚀

Elastic modulus 弹性模量

Hardness 硬度

Brittleness 脆性 /fragility

fracture/rupture 断裂

Creep 蠕变

rigidity 刚度

Yield strength 屈服强度
Tensile strength 抗拉强度
plastic deformation
塑性变形
body-centered cubic
体心立方
face-centered cubic
面心立方
tetragonal 四方的

ionic bond 离子键
covalent bond 共价键
metallic bond 金属键
Transparent 透明的
opaque 不透明的
Translucent 半透明的

其它常用词汇

Cast 铸造

Welding 焊接

Forging 锻造

Forming 成型

Annealing 退火

Strain 应变

Stress 应力

Quench 淬火

Tempering 回火

Rolling 轧

Bending 弯曲

Drawing 拉拔

其它常用词汇

Amorphous

Crystalline

Crystallize

Crystallinity

Crystal

Tensile

Compressive

Heterogeneous

Homogeneous

Anisotropic

Isotropic

Domain

Dipole

Dislocation

Displacement

其它常用词汇

Metal

Ceramic

Polymer

composite

Ferrous alloy

Non-ferrous alloy

Plain carbon steel

Wrought iron

Stainless steel

Cast iron铸铁

Pig iron 生铁

porcelain瓷器

pottery陶器

其它常用词汇

Capacitor 电容器

Refractory 耐火的

Conductor 导体

Insulator 绝缘体

Electric resistivity 电阻

Capacitance 电容

Thermal expansion coefficient

Portland cement 硅酸盐水泥

Thermal resistance

Shock resistance

Corrosion resistance

Resistance to combustion

Thermoplastic 热塑性的

Thermosetting 热固性的

What is Materials Science?

Materials simply are atoms joined together in the solid state. Materials Science studies the fundamental physical and chemical basis for the controlled combination of atoms to form new compounds, phases and microstructures, as well as the characterization of the resulting structures and properties. The great diversity of materials reflects the enormous variety in the strength and directionality of atomic bonding. Indeed, the bulk properties of a material are determined by its atomic architecture.

Materials Engineering

Materials engineering focuses on the synthesis of materials in useful quantities, and on the processing of component materials into engineering products. Materials Engineering draws heavily on the fundamental knowledge gained from Materials Science, and adapts the processes involved for the scale and requirements of the application.

There is a rich interplay between the science and engineering aspects. Basic studies frequently find ways to improve the properties of materials, and goal-oriented engineering often reveals aspects of performance that challenge the basic understanding.

Carbon and alloy steel

Carbon steel

A plain carbon steel is one in which carbon is the only alloying element. The amount of carbon in the steel controls its hardness, strength, and ductility. The higher the carbon content, the harder the steel.

Carbon steels are classified according to the percentage of carbon they contain. They are referred to as low, medium, high, and very-high-carbon steels.

Low-carbon steels

Steels with a carbon range of 0.05 to 0.30 percent are called low-carbon steels. Steels in this class are tough, ductile, and easily machined, formed, and welded. Most of them do not respond to any heat treating process except case hardening.

Medium-carbon steels

These steels have a carbon range from 0.30 to 0.45 percent. They are strong and hard but cannot be worked or welded as easily as low-carbon steels. Because of their higher carbon content, they can be heat treated. Successful welding of these steels often requires special electrodes, but even then greater care must be taken to prevent formation of cracks around the weld area.

High and very-high-carbon steels

Steels with a crabon range of 0.45 to 0.75 percent are classified as high-carbon and those with 0.75 to 1.7 percent carbon as very-high-carbon steels. Both of these steels respond well to heat treatment.

As a rule, steels up to 0.65 percent carbon can be welded with special electrodes, although preheating and stress relieving techniques must often be used after the welding is completed. Usually it is not practical to weld steels in the very-high-carbon range.

Carbon is the principal element controlling the structure and properties that might be expected from any carbon steel. The influence that carbon has in strengthening and hardening steel is dependent upon the amount of carbon present and upon its microstructure. Slowly cooled crabon steels have a relatively soft iron pearlitic microstructure; whereas rapidly quenched carbon steels have a strong, hard, brittle, martensitic microstructure.

In carbon steel, at normal room temperatuare, the atoms are arranged in a boy-centered lattice. This is known as alpha iron. Each grain of the structure is made up of layers of pure iron (ferrite) and a combination of iron and carbon. The compound of iron and carbon, or iron carbide, is called cementite. The cementite is very hard and has practically no ductility.

In a steel with 0.8 percent carbon, the grains are pearlitic, meaning that all the carbon is combined with iron to form iron carbide. This is known as a eutectoid mixture of carbon and iron.

If there is less than 0.8 percent carbon, the mixture of pearlite and ferrite is referred to as hypoeutectoid. An examination of such a mixture would show grains of pure iron and grains of pearlite as shown in Figure 2.2.

When the metal contains more than 0.8 percent carbon, the mixture consists of pearlite and iron carbide and is called hypereutectoid. Notice in Figure 2.3 how the grains of pearlite are surrounded by iron carbide. In general, the greatest percentage of steel used is of the hypoeutectoid type, that which has less than 0.8 percent carbon.