化学专业英语

Chemistry English

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第一版前言

《化学专业英语》课程已成为化学、化工等相关学科本科生掌握专业英语的必修课。如何在短时间内迅速掌握最基本的词汇、表达方式、常用语句，并能学习到学科前沿知识，是目前困扰化学专业英语学习者的主要问题。因而，许多学校在开设化学双语教学时感到十分困难，考研的学生也无法面对老师提出的化学专业英语问题。基于这些原因，我们精心组织编写了这本教材。

本书共32课和14个附录，均取材于美国大学教科书和专业资料。内容涉及无机化学、分析化学、环境化学、环境工程、有机化学、物理化学、材料化学。尤其专业前沿知识和附录是本书的一大特色。诺贝尔化学奖(1901—2005)获得者及其成就会激励学生；无机、有机、分析和物化领域常用专有名词可使学生在短时间内掌握专业英语术语；前缀和后缀对学生英语构词有快捷实用的帮助；有机词尾可助学生迅速扩充专业词汇；某些结构的读法可使学生增强口语能力；仪器的英文对照可帮助学生应用。

总之，本书内容丰富，取材有代表性和前沿性，也是一本难得的化学专业英语资料，适合综合性大学、师范大学及其他本科院校化学化工专业的师生使用或参考。

由于我们水平有限，不妥和疏漏也恐难免，还望读者多提宝贵意见。

周光明

2006年5月于重庆北碚

第二版前言

《化学专业英语》第一版使用到现在，仅仅历时 2 年。本书在推广使用的过程中，产生了良好的社会效益，很多相关学校和师生给予了本书很好的评价，认为本书内容丰富，特色鲜明，实用性强，是一本不可多得的兼有教材和资料工具书性质的专业英语教材。本书的面市，为捆扰多年的化学专业英语教学中的主要问题的解决提供了很好的帮助和尝试。

社会的反响和读者的建议，使我们不敢有丝毫的懈怠！根据教材在使用中发现的一些问题和化学专业英语教学形势发展的需要，以及一些教学单位好的建议，我们随即对教材做了以下的修订：

一、着眼于化学专业英语属于学科公共课的性质，注重课程的基础性和语言的工具性，要求选录的课文理论不能太深，专业面不能太窄。因此，在修订中删掉了一些不适合的课文，增强了选文的通俗性和可读性。经过优化，正文由原来的 32 课调整为 28 课。

二、注重了化学物质命名的系统性。本次修订，在一般无机物命名后，增加了配位化合物的命名；在碳氢化合物及其基团命名后，增加了其他有机物的命名，系统讲述了醇、醛、酮、羧酸、醚、酯等物质的命名方法。这样，本书在物质的命名上更具有系统性。

三、本书特别注重物质命名一般规律和特殊命名相结合的原则。有机物的命名是课程的重点，对在正文中不可能大量涉及的特殊规律和特殊物质的名称，以附录的形式呈现给读者，也给教学提供了广阔的空间。

四、更加重视对学生英语科技论文写作素养的培养。在第一版正文的最后增加了一课，系统讲述了如何写好具有科技期刊风格和格式的英语论文，并在课后附上了一篇原汁原味的科技论文，让读者就科技论文的一般构成要素和写作风格有直观深刻的感悟和领会。

五、注重化学专业英语词汇的学习和积累。克服了原附录3“实用英语构词法”中选词过于宽泛的缺点，更加突显化学专业特点，重新增添和精选了一些化学词汇，这对学生的终身学习都是有好处的。

六、在附录1“化学诺贝尔奖获得者及其贡献”中，增补了2006，2007年的人物和成果。

总之，本书的修订再版，凝聚了我们做好本书的满腔热忱和不懈追求！但由于我们水平和精力有限，对专业英语教学的探索不够深入，书中的不妥和疏漏还是在所难免，再加上各个学校专业英语教学情况的巨大差异，使我们在教材的教学资源建设方面显得力不从心，几年的心愿仍未了却。

广大读者对我们的厚爱、鼓励和期待，既是压力，更是激励我们不断前进的动力！打造一本附有优质教学资源的化学专业英语精品教材仍是我们的心愿！

编者

2008年7月于西南大学

Table of contents

1 What Is Chemistry?

History of chemistry

1. Chemistry is a science that tries to understand the properties of substances and the changes that substances undergo. It is concerned with substances that occur naturally — the minerals of the earth, the gases of the air, the water and salts of the seas, the chemicals found in living creatures and also with new substances created by humans. It is concerned with natural changes — the burning of a tree that has been struck by lightning, the chemical changes that are central to life — and also with new transformations invented and created by chemists.
2. Chemistry has a very long history. In fact, human activity in chemistry goes back to prerecorded times.
3. As the quotation at the head of this chapter indicates, chemists are involved in two different types of activity. Some chemists investigate the natural world and try to understand it, while other chemists create new substances and new ways to perform chemical changes that do not occur in nature. Both activities have gone on since the first appearance of humans on earth, but the pace has increased enormously in the last century or so.
4. Curiosity about natural substances led to some of the earliest adventures in isolating pure chemical materials from nature. Humans discovered that they could extract the colors from flowers and some insects and use them to make pictures and to dye cloth. Only in the last century have chemists learned the detailed chemical structures of these natural colors. From earliest times humans have also been making new substances by performing chemical transformations. The first such new substances were probably soap and charcoal.
5. When wood is heated it loses water and produces charcoal. In this process the cellulose of wood — a chemical compound containing carbon, hydrogen, and oxygen all linked by chemical bonds — undergoes a chemical reaction that breaks the hydrogen and oxygen away as water and leaves the carbon behind as charcoal. A major chemical change has occurred — the process cannot be reversed to make cellulose again by just mixing the charcoal with water, since the oxygen and hydrogen atoms will not spontaneously form the needed bonds to carbon. Charcoal burns with a flame hotter than that of wood. Archaeological records indicate that charcoal has been used since prehistoric times.
6. Perhaps even earlier came the creation of soap. Soap is not a natural substance, but it can be made by heating fats with alkali to break some chemical bonds that link fatty

acids to glycerin. Soaps are just the alkali salts of the resulting fatty acids. Since alkalis are formed when wood burns and are found in the ashes of wood fires, it is believed that the earliest humans noticed the unusual substances produced from fats that had dripped onto cooking fires.

7. These early "Chemists" made such discoveries by accident, and for a long time accident was the principal means of discovery. Accident still remains important to discovery, but with our increasing chemical understanding we now usually create new chemical substances by design.

8. After the early period of random discovery, humans began heating substances together intentiona lly to see what occurs. When a material that we now call iron ore was heated with charcoal, it produced iron metal, a new substance (we now use coke, produced from coal, instead of charcoal). Iron ore contains a chemical in which iron atoms are chemically bound to oxygen atoms. Heating it with charcoal lets the carbon atoms of charcoal bind to the oxygen atoms and carry them off as the gas carbon monoxide, leaving iron behind. Only gold and some metals related to platinum occur naturally as metals; all others are made from their ores by such chemical processes.

9. When copper and tin were heated together, the copper atoms and tin atoms linked up with metallic bonds, producing the alloy bronze, which is harder than either copper or tin. In the Bronze Age, starting at about 3600 BC, the hardness of this metallic alloy made it the dominant material for tools and weapons. Bronze was the first metal that could hold a sharp edge.

10. Egyptians made glass as early as 1400 BC by heating some natural minerals together. Glass is formed when this heating caused major chemical changes.

11. Much of the rise of civilization has involved humans creating new substances by transforming natural ones to better meet their needs. Tanning hides to make leather, for example, changes their chemical nature. Even cooking foods alters their chemical structures. Every substance in the world is made up of "chemicals", either in the form of chemical compounds in which a-toms are linked by chemical bonds or, in a few cases such as helium gas, as unlinked atoms. No substance can be called "chemical-free". Indeed, "natural" chemicals do not always have advantages. Some of the most dangerous poisons known are natural chemicals, produced by bacteria and other living things.

12. Modern chemistry is devoted to understanding the chemical structures and properties of natural chemicals and of chemicals created by building on what nature has supplied. The remainder of this book will describe many of the contributions to everyday life resulting from this knowledge, and a sample of what is left to be done by the current and future generations of chemists.

Fundamental principle of chemistry

13. The first and most important principle is that chemical substances are made up of molecules in which atoms of various elements are linked in well-defined ways. The second principle is that there are somewhat more than 100 elements, which are listed in the pe-

riodic table of the elements. The third principle is that those elements, arranged according to increasing numbers of protons in their nuclei, have periodic properties. That is, as the elements increase in their atomic number (number of protons in the nucleus), every so often and element appears that is similar in its properties to one that has occurred earlier in the table. For example, after lithium, with three protons in the nucleus, come other elements whose properties are decreasingly like those of lithium until suddenly sodium appears, with a nucleus containing 11 protons. Sodium is quite similar to lithium in many respects. The arrangement of the periodic table puts such similar elements below each other in columns. Chemical reactions that lithium undergoes will also occur with sodium, although not with the same speed or energy; lithium and sodium are similar, but not identical.

14. Another principle is that the ways in which atoms are linked strongly affects the properties of chemical substances. This is particularly evident when covalent links (bonds) are involved. Covalent bonds, in which two atoms are held together by a pair of electrons shared between them, are the bonds that hold the atoms of carbon, oxygen, and hydrogen together in cellulose, for instance. Most covalent bonds do not break easily, which is why intense heating is needed to turn cellulose into charcoal. The precise arrangement of the links determines chemical properties. By contrast, a salt such as sodium chloride has what are called ionic bonds. The sodium and the chlorine are not directly linked, just held together by the attraction of the positive sodium ion for the negative chloride ion. When sodium chloride is dissolved in water, the sodium ion and the chloride ion drift apart.

15. There is another much more subtle difference among chemical structures that has to do with the three-dimensional arrangement of atoms in space. Two chemicals can differ, even when all the same atomic linkages are present, if the spatial arrangements are different. Differences in spatial arrangement can have several aspects, but the most interesting has to do with handedness, or what chemists call chirality. When a carbon atom carries four different chemical groupings, there are two different ways they can be arranged. For example, in the amino acid alanine the central carbon atom carries four different groups: a hydrogen atom, a nitrogen atom, and two carbon atoms that differ in what is attached to them.

[引自《化学的今天和明天》]

Vocabulary

be concerned with 参与，干预
be concerned about 关心，挂念
mineral ['minərəl] *n.* 矿物，矿石
chemical['kemikəl] *adj.* 化学的 *n.* 化学制品，化学药品
creature['kriːtʃə] *n.* 人，动物
strick[straik] *vt.* 打；击；捶击
lightning['laitniŋ] *n.* 闪电 *adj.* 闪电的，快

速的
transformation[ˌtrænsfəˈmeiʃən]n. 变化,转化,改革,转换
go back to 回去
prerecord[ˈpriːriˈkɔːd]vt. 预先录制
times [ˈtaimz]n. 时期,次,倍数,乘
quotation[kwəuˈteiʃən]n. 引用语,价格,报价单,行情表
be involved in 涉及,专心
go on 继续下去,过去,发生,进行
or so 左右,上下,大约
curiosity[ˌkjuəriˈɔsiti]n. 好奇心
lead to 导致,产生,通向
adventure[ədˈventʃə]n. 冒险,冒险的经历 v. 冒险
isolate[ˈaisəleit]vt. 使隔离,使孤立,使绝缘,离析 n. 隔离种群
colors [ˈkʌləs] n. 色料,着色剂,颜料
insect[ˈinsekt]n. 昆虫,卑鄙的人 adj. 虫的
dye[dai]n. 染料,染色 vt. 染 v. 染
cloth[klɔ(ː)θ]n. 布,织物,衣料
soap[səup]n. 肥皂 vt. 用肥皂洗
charcoal[ˈtʃɑːkəul]n. 木炭
cellulose[ˈseljuləus]n. 纤维素 adj. 细胞的
spontaneously [spɔnˈteiniəsli] adv. 自然地,本能地
archaeological[ˌɑːkiəˈlɔdʒikəl]adj. 考古学的,考古学上的
prehistoric[ˈpriːhisˈtɔrik]adj. 史前的,陈旧的
fat[fæt]n. 脂肪,肥肉 adj. 肥大的,丰满的,肥的,胖的,油腻的 n. 文件分配表
alkali[ˈælkəlai]n. 碱 adj. 碱性的
glycerin[ˈglisərin]n. 甘油,丙三醇
alkalis[ˈælkəlis]n. 碱金属
cooking[ˈkukiŋ]n. 烹饪
by accident 偶然
principal[ˈprinsəp(ə)l, - sip-]n. 负责人,首长,校长,主犯,本金 adj. 主要的,首要的
design[diˈzain]n. 设计 v. 设计,计划,谋划,构思
random[ˈrændəm]n. 随意,任意 adj. 任意的,随便的,胡乱的 adv. 胡乱地
intentionally [inˈtenʃənəli] adv. 有意地,故意地
iron ore 铁矿石
coke[kəuk]n. 可乐,焦炭 v. (使)成焦炭
link up 连接,会合
alloy[ˈælɔi]n. 合金 vt. 使成合金,减低成色
bronze[brɔnz]n. 青铜(铜与锡合金),铜像 adj. 青铜色的
dominant[ˈdɔminənt]adj. 有统治权的,占优势的,支配的 adj. [生物]显性的
sharp edge 薄边
civilization[ˌsivilaiˋzeiʃən; - liˋz-]n. 文明,文化,文明社会
tanning[ˈtæniŋ]n. 制革法,皮肤晒成褐色
hide[haid]n. 兽皮,皮革 v. 剥...的皮,痛打,隐藏,掩藏,隐瞒,掩饰
poison[ˈpɔizn]n. 毒药 vt. 毒害,败坏,使中毒 vi. 放毒,下毒
bacteria[bækˈtiəriə]n. 细菌
be devoted to 致力于
remainder[riˈmeində]n. 残余,剩余物 v. 廉价出售 adj. 剩余的,出售剩书的
proton[ˈprəutɔn]n. 质子
nuclei[ˈnjuːkliai]n. 核 (nucleus 的复数形)
identical[aiˈdentikəl]adj. 同一的,同样的
evident[ˈevidənt]adj. 明显的,显然的
drift apart (两者)漂移,疏远
subtle[ˈsʌtl]adj. 敏感的,微妙的,精细的,稀薄的
handedness [ˋhændidnis] n. 手性,螺旋性
chirality[ˈtʃirəliti]n. 手征,手性
amino acid 氨基酸
alanine[ˈæləˌniːn]n. 丙胺酸
be attached to 附属于,喜爱

Translation

1.什么是化学?

化学的历史

1.化学是一门试图了解物质的性质和物质发生反应的科学。它涉及存在于自然界的物质：地球上的矿物,空气中的气体,海洋里的水和盐,在动物身上找到的化学物质以及由人类创造的新物质。它涉及自然界的变化——因闪电而着火的树木,与生命有关的化学变化——还有那些由化学家发明和创造的新变化。

2.化学的历史悠久。事实上,人类的化学活动可追溯到有历史记载以前的时期。

3.正如本章一开始所指出的那样,化学包含着两种不同类型的活动。有些化学家在研究自然界并试图了解它,同时另一些化学家则在创造自然界不存在的新物质和完成化学变化的新途径。自人类出现在地球上那一刻起,这两方面的活动就都有了,但是在上一个世纪以来它们的步伐大大地加快了。

4.对自然界物质的好奇心,使得人们很早就在从自然界分离纯粹化学物质方面进行了大胆探索。人们已经发现,可以从花卉和某些昆虫提取颜料,并用来作画和染布。直到上个世纪,化学家才弄清楚这些天然颜料的详细化学结构。人类很早就在通过化学变化来制造新物质,这类新物质中,最早的可能是肥皂和活性炭。

5.加热木材时,它将失去水分并生成活性炭,在这个过程中,木材中的纤维素——一种含有碳、氢和氧,并全由化学键连结在一起的化合物发生了化学反应,使氢和氧断裂下来变成水而失去,剩下的碳成为活性炭。这是发生的主要化学变化。但是,仅靠把活性炭和水混在一起,不能使这个过程反过来生成纤维素。因为氧原子和氢原子不能自发地与碳生成所需的键。活性炭燃烧时的火焰温度比木材要高。考古文献表明,活性炭在史前时期已经得到应用。

6.肥皂的出现可能还要早些。肥皂不是一种天然产物,但它可以通过加热脂肪和碱使连接脂肪酸和甘油的某些键断裂的办法来制造。肥皂就是脂肪酸和碱生成的盐。因为木材燃烧时能够生成某些碱,这在木材燃烧后的灰烬中可以找到。所以人们相信,古代人类是从脂肪滴到烹调时的火焰上以后,才开始注意到所产生的这种不寻常的物质的。

7.早期的这些“化学家们”的发现多属于偶然,而且在相当长的时间里,偶然性是发现的主要途径。偶然性对于发现至今仍然是重要的,但是随着人们化学知识的增长,现在我们经常通过设计来创造新的化学物质。

8.当有了早期的随机发现的经验之后,人类开始有意识地将物质放在一起加热,看看会出现些什么。当一种我们现在称之为铁矿的物质和木炭一起加热时,产生了一种新物质金属铁(我们现在用由煤生产的焦炭来代替木炭)。铁矿中含有一种化合物,其中的铁原子是和氧原子化合在一起的。当和木炭一起加热时,让木炭中的碳原子和氧原子结合并以一氧化碳气体的形式把它们带走,遗留下来的就是金属铁。以金属形式天然存在的只有金和与铂相关的一些金属,其他所有的金属都是通过这类化学过程从它们的矿石中得到的。

9. 当铜和锡一起被加热时，铜原子和锡原子以金属键相连接，生成青铜合金，它比铜或锡都硬。在公元前大约 3600 年的青铜时代，这种金属合金的坚硬使得它成为制造工具和武器的主要材料。青铜曾经是第一种能够保持锋利边缘的金属。

10. 埃及人早在公元前 1400 年就会通过把一些天然矿物共热制造玻璃，当加热使主要反应发生时，就生成了玻璃。

11. 文明的进步涉及人类创造新物质以满足需要，而这些新物质则是由天然物质转变而成的。例如，把皮革染成褐色，已改变了它的化学性质。即使是烹调食物，也会改变它们的化学结构。世界上的万物都是由“化学物质”构成的，或者以化合物的形式存在，其中的原子以化学键连结在一起；或者在少数情况下以未与其他原子连结的形式存在，如氦气。没有可以称之为“与化学物质无关”的物质。实际上，“天然”化学物质并不总是对人有益的。已知由微生物和其他生物产生的某些天然化合物，就属于最危险的毒物之列。

12. 现代化学致力于了解天然化合物的化学结构、性质和制造自然界已有的化合物构成的化学物质。本书的其他部分将从这些知识出发，介绍化学对日常生活所作的许多贡献，并举一些例子来加以说明，还有哪些问题是今天和明天的化学家将要解决的。

化学基本原理

13. 第一条也是最重要的原理是，化学物质是由分子组成的，分子中的不同元素的原子是以一定的方式连结在一起的。第二条原理是，现在已有大约 100 多种元素被排列在元素周期表中。第三条原理是，这些元素是按照它们核内质子数目的递增而排列的，表现出周期性。亦即，当这些元素的原子序数(核内的质子数)增加时，每个元素经常表现出和已排在周期表中的某个元素有相似的性质。例如，在核中有 3 个质子的锂之后，接下来的元素的性质和锂的相似程度递减，直至核中有 11 个质子的钠出现后又变得相似起来。锂和钠在许多方面十分相似。周期表在排列时，把这类相似的元素排成一列。锂所发生的反应，钠也会发生，虽然速率和能量不同；锂和钠只是相似而不是完全相同。

14. 还有一条原理是，原子连结的方式将强烈地影响着化学物质的性质。当包含有共价(键)时特别明显。形成共价键时，两个原子靠它们之间公用的一对电子把它们连结在一起。例如，纤维素中连结碳原子、氧原子和氢原子的键就是共价键。大多数共价键是不容易断裂的，这就是为什么要把纤维素变成活性炭需要强热的原因。化学键的精细排列决定着化学性质。与此相反，像氯化钠一类的盐类则含有所谓的离子键。钠和氯不是直接连结在一起的，是靠带正电的钠离子和带负电的氯离子相吸引在一起的。当氯化钠溶于水时，钠离子和氯离子就各自分开了。

15. 至于原子在空间里的三维排列的化学结构之间、还要考虑更为精细的差别。两种化学物质间，即使存在着完全相同的原子键合，只要空间排列不同，这两种化学物质就可以区分开来。空间排列的差别可以有许多方面，但是最有趣的是手对称性，化学家称之为手性。当一个碳原子与 4 个不同的原子(团)相连时，有两种不同的空间排列方式，例如，丙胺酸的中心碳原子与 4 个不同的原子(团)相连：1 个氢原子，1 个氮原子和 2 个不同的基团的碳原子。

2 More about Chemistry as the Useful Science

The future

1. Considering the enormous range of topics in this chapter, it is impossible to cover the likely developments in all the fields. However, some advances will have a wide impact.

Modern structural materials

2. Many of the uses of chemistry involve novel solid materials, with improved properties. This is particularly true of what are called composites. These are combinations of materials in which the individual components cooperate. An example is the "graphite" used in some modern tennis rackets, golf clubs, and skis. It consists of bundles of graphite fibers (graphite is the black material in pencils) produced by high heating of a synthetic polymer, imbedded in a synthetic material such as epoxy resin. The resin helps hold the fibers together and protects them from breakage, while the fibers give strength to the composite that the resin alone does not have.
3. Composites are very old. In early civilization people learned that they could make bricks using straw as the fiber and clay as the other component, and that such bricks were not as fragile as those made from clay alone. More recently, fiberglass was invented using glass fibers held together with a synthetic resin, a polyester. The very thin glass fibers are flexible, unlike thick glass.
4. Modern composites are good, but not yet ideal. They are very strong and yet light in weight, so they are extensively used in aircraft and in automobiles. However, they do not stand up to high heat, and some are hard to machine. It is clear that the future will bring composite materials with greatly improved properties and lower cost. We can expect to see the metal in vehicles increasingly replaced by such materials. Furthermore, they may increasingly find use as structural materials in bridges, for instance, in which strong lightweight materials are needed.
5. The advances in composites are guided not merely by random experimentation. Modern techniques let chemists understand the detailed molecular structures inside a composite and how to optimize them.
6. Ceramics, such as one sees in cups and saucers, have many desirable properties, but they can be fragile. Composites can be made by imbedding graphite or polymer fibers in the ceramic, and they are then much less breakable. Ceramic composites can even be used for very high temperature applications, such as in rocket engines for spacecraft.
7. For many materials the exposed surfaces are particularly important. Thus a material with useful bulk properties—either a simple solid material or a composite—can be made with a surface coating of another material to give the special surface properties needed. Early examples of surface coating include paint and the chrome plating of steel. Modern

materials chemists are developing other special materials for surface coatings. Since the surface layer is often quite thin, an expensive material can be used if its properties are worth it. An interesting example is the development of methods to apply a thin coating of diamond onto metals, which then become very tough and scratch-resistant. This can be thought of as a special example of an important general goal—indestructible paint that protects metals parts for many decades.

8. The field of chemistry is increasingly concerned with the properties of organized mixtures of substances, not just of pure substances such as nylon and bakelite. This shift in focus can be seen as an orderly intellectual transition. At first chemists looked at complex materials, such as the wood, in trees, and separated them into their components. They identified the chemical nature of cellulose, and of the lignin in wood that is removed when wood is converted to paper. Now there is increasing interest in the chemistry of the interacting components, not just the pure substances. This new emphasis is also true in biochemistry, where chemists first had to identify all the molecules of life and their properties. Now there is increasing interest in the chemical interactions among these molecules within the cell.

9. Many devices already have complex arrangements of different chemicals. Photographic film at one point consisted simply of silver chloride crystals imbedded in a synthetic plastic, but modern color photographic film has many layers containing different dye chemicals. An integrated-circuit chip, which makes modern computing possible, consists of many layers of specialized materials on a pure silicon wafer. If the chemistry can be mastered, even better devices are envisioned for the computers of the future. In addition, there is one other area in which advances will revolutionize our use of electricity。

Superconductors

10. Normal electrical conductors, such as copper wire, resist the flow of electricity to some extent, turning part of the electric power into heat. It has been known for many years that a few such conductors become superconductors at very low temperatures. In a superconductor there is no electrical resistance, and thus electricity is transmitted with complete efficiency. It would clearly be better if our power lines were constructed using superconductors, so no electricity is wasted.

11. In addition, there are potential applications of superconductors in magnets and in electronic devices. In fact, some scientific magnets are already constructed with present-day superconductors. They must be cooled close to the lowest possible temperature — called absolute zero (−273℃, −459°F)—using liquid helium as the coolant, before they become superconducting.

12. This need for extremely low temperatures is a problem. It is simply not practical to cool transcontinental power lines with liquid helium. What is needed is a superconductor that operates at higher temperatures. The ideal is a room-temperature superconductor, but even one that operated at the temperature of liquid nitrogen (−196 ℃) would be useful. The air is 80% nitrogen, and turning it liquid by compressing it is not very expensive.

13. Recent breakthroughs in materials chemistry suggest that practical superconductors operating at such temperatures may be within reach. Interestingly, among the best so far are special ceramics, materials like porcelain but containing very specific extra chemicals. The remarkable thing is that these become superconductors at easily accessible temperatures, but above those temperatures they are actually insulators. They are not even electrical conductors except when they are cooled into the superconducting state. If these materials can be improved, and this is an area of very active chemical research, they could usher in an era in which power could be generated where convenient, and transferred throughout the country very efficiently.

14. Another area in which we can expect great advances relates to our food.

Food supplies

15. Chemistry plays a role in the production of food, with modern agricultural methods and animal health products, and in the processing of food for our consumption. Chemistry also brings us more knowledge about what is in our foods, and what should be in a healthful diet.

16. With improved agricultural chemicals we should be able to increase the productivity farmland. Insect control will be achieved using selective environmentally friendly new insecticides, some based on the detailed chemistry that insects themselves use. Fertilizers will better meet the needs of food plants, and weed control will help ensure that vital sunlight, fertilizer, and water go only to the food crops.

17. We are now much more sensitive to the matter of contamination of food. Chemists will continue to test food and help defend it against spoilage and bacterial contamination. Improved packaging makes it possible to store many foods without refrigeration, and this technology will expand further in the future. Intelligent concerns about the effects of intentional and unintentional food additives will also be addressed.

18. New agricultural chemicals will be developed to replace those that raise questions. For instance, farm animals are frequently treated with antibiotics to decrease disease, but we don't want those antibiotics to end up in our foods. Some otherwise effective antibiotics are now banned for use in food animals because of this concern, and they will be replaced with improved medicinal agents.

19. Food spoilage can be prevented with antioxidant chemicals, but those that should be used are the ones that also bring human health benefits, as some do. Food colorings increase the appeal of some foods, but not if they have questionable effects on the consumers.

20. We need to develop new agricultural and food chemicals that have no unwanted side effects. Now that this requirement is completely clear, there is very active research to develop the products of the future. Only recently have we all become sensitive to these matters. They represent a tremendous challenge and opportunity for modern chemistry, and for the chemists of the future.

[引自《化学的今天和明天》]

Vocabulary

enormous[iˈnɔːməs]*adj*. 巨大的，庞大的
impact[ˈimpækt]*n*. 碰撞，影响，*vt*. 挤入，撞击，压紧，对...发生影响
structural[ˈstrʌktʃərəl]*adj*. 结构的，建筑的
composite[ˈkɔmpəzit, - zait]*adj*. 合成的，复合的 *n*. 合成物
tennis[ˈtenis]*n*. 网球 *adj*. 网球的 *vi*. 打网球
racket[ˈrækit]*n*. 球拍
golf club 高尔夫俱乐部
ski[skiː, ʃiː]*n*. 滑雪橇 *vi*. 滑雪
bundle[ˈbʌndl]*n*. 捆，束，包 *v*. 捆扎
fiber[ˈfaibə]*n*. ＝fibre 光纤
imbed[imˈbed]*v*.（＝embed）埋藏，埋入
epoxy resin 环氧树脂
straw[strɔː]*n*. 稻草，麦杆
clay[klei]*n*. 粘土
fiberglass[ˈfaibəglɑːs]*n*. 玻璃纤维,玻璃丝
polyester[ˈpɔliestə]*n*. 聚酯
flexible[ˈfleksəbl]*adj*. 柔韧性
aircraft[ˈɛəkrɑːft]*n*. 航行器，飞行器
automobile[ˈɔːtəməubiːl, ˌɔːtəˈməubil]*n*. 汽车（＝<英>motor car,car）
stand up to 经受，经得住，对抗
machine[məˈʃiːn]*n*. 机器 *vt*. 机器制造，用车床加工
vehicle[ˈviːikl]*n*. 交通工具
lightweight[ˈlaitweit]*n*. 轻量级选手 *adj*. 轻的,重量轻的
optimize[ˈɔptimaiz]*vt*. 使最优化
ceramics[siˈræmiks]*n*. 制陶术，制陶业
saucer[ˈsɔːsə]*n*. 茶托，碟子，茶碟
fragile[ˈfrædʒail]*adj*. 易碎的，脆的
rocket[ˈrɔkit]*n*. 火箭 *v*. 飞速上升
spacecraft[ˈspeiskrɑːft]*n*. 太空船，宇宙飞船
coating[ˈkəutiŋ]*n*. 被覆，衣料
tough[tʌf]*n*. 恶棍 *adj*. 强硬的，凶恶的，粗暴的
indestructible[ˌindiˈstrʌktəbl]*adj*. 不能破坏的，不可毁灭的
paint[peint]*n*. 油漆，颜料，涂料 *v*. 油漆，描绘
nylon[ˈnailən]*n*. 尼龙
bakelite[ˈbeikəlait]*n*. 酚醛塑料
intellectual[ˌintiˈlektjuəl]*adj*. 智力的，有智力的 *n*. 知识分子
cellulose[ˈseljuləus]*n*. 纤维素
lignin[ˈlignin]*n*. 木质素
photographic[fəutəˈgræfik]*adj*. 照相的摄影的
plastic[ˈplæstik, plɑːstik]*n*. 塑胶 *adj*. 塑胶的，整形的
integrated-circuit chip 集成电路芯片
wafer[ˈweifə]*n*. 晶片 *vt*. 用干胶片封
envision[inˈviʒən]*vt*. 想象，预想
revolutionize[ˌrevəˈl(j)uːʃənaiz]*vt*. 革命化，使...发生巨大变化
superconductor[ˌsjuːpəkənˈdʌktə]*n*. 超导（电）体
resistance[riˈzistəns]*n*. 反抗，电阻
transmit[trænzˈmit]*vt*. 传输，转送 *vi*. 发射信号，发报
magnet[ˈmægnit]*n*. 磁体，磁铁
coolant[ˈkuːlənt]*n*. 冷冻剂，冷却液，散热剂
transcontinental [ˈtrænzkɔntiˈnentəl] *adj*. 横贯大陆的
breakthrough[ˈbreikˈθruː]*n*. 突破
reach[riːtʃ]*n*. 延伸，范围 *vt*. 到达，达到 *vi*. 达到，延伸，伸出手，传开
porcelain[ˈpɔːslin, - lein]*n*. 瓷器，瓷 *adj*. 瓷制的
insulator[ˈinsjuleitə]*n*. 绝缘体，绝热器
usher[ˈʌʃə]*n*. 招待员,前驱 *vt*. 引导，展示