科技英语丛书

English for Chemistry and Chemical Engineering

化学化工专业英语

主编 范东生 姚如富

中国科学技术大学出版社

科技英语丛书

化学化工专业英语

English for Chemistry and Chemical Engineering

主　编　范东生　姚如富
副主编　夏卫华　沙茂林　胡　静
参　编　吴　蓓　罗发宝　王艳萍

中国科学技术大学出版社

内 容 简 介

本书用英语介绍了一般科技论文的写法，包括标题、摘要、文献等，同时介绍了从事化学工作的基础知识，如实验室工作的注意事项、安全要求、反应的跟踪、产物分离和表征等，还介绍了无机化学、有机化学、物理化学、分析化学、环境化学和生物化学等专业知识。通过对本书的学习，可基本掌握化学专业英语的语音和一些构词规律，可熟记约3000个专业英语词汇，理解一些语法概念，从而为撰写专业英语稿件和进行国际学术交流打下坚实的基础。

本书可供化学、化工和材料类专业的学生使用，也可作为研究生、教师及相关领域研究人员的学习参考书。

图书在版编目(CIP)数据

化学化工专业英语/范东生，姚如富主编. —合肥：中国科学技术大学出版社，2011.8
ISBN 978-7-312-02854-0

Ⅰ.化…　Ⅱ.①范…　②姚…　Ⅲ.①化学—英语—高等学校—教材　②化学工业—英语—高等学校—教材　Ⅳ.H31

中国版本图书馆CIP数据核字(2011)第172985号

出版　中国科学技术大学出版社
地址：安徽省合肥市金寨路96号，230026
网址：http://press.ustc.edu.cn
印刷　合肥义兴印务有限责任公司
发行　中国科学技术大学出版社
经销　全国新华书店
开本　710 mm×960 mm　1/16
印张　13.25
字数　250千
版次　2011年8月第1版
印次　2011年8月第1次印刷
定价　25.00元

前　　言

在21世纪开始的第一个十年，中国融入世界经济发展一体化的程度超过了以往任何一个时期。我国科学技术的发展与世界接轨已经是非常现实的事情。大学里的公共英语教育正在向专业英语教育发展转变。采用英语进行专业教学正日益成为广大师生的实践要求。为了适应这一要求，我们编写了这本《化学化工专业英语》教材，参加编写的人员有英语和化学专业的资深教授、博士和讲师等。

教材设计的指导思想是，要使学生通过学习本教材，既掌握化学专业的基础知识和化学专业领域的最新发展成果，又提高英语的专业阅读能力和翻译能力，以及用英语进行口头交流的能力。学生在掌握了一定的专业术语和翻译、口语表达方面的能力之后，未来能够轻松应对各种国际交流，阅读各种国际期刊或专著，并进行英文学术论文写作等。

打开教材，可以发现它具有这样一些特点：

1.教材内容具有基础性、前沿性和趣味性。所选课文既反映化学基础知识概念，如“什么是化学”，“分子结构”等，又有介绍21世纪化学专业的最新发展的内容，如在“什么是液体”中，介绍离子液体的研究进展；在“化学和材料”中介绍了最新的陶瓷材料；在“化学和电”中，从电化学的发展历程到最新的若干种电池的研究都有介绍。这些课文都体现了专业内容的快速更新。部分课文还介绍了一些有趣的化学物质名称。课文内容准确，具有一定概括性，文字流畅，难度适中，能体现现代专业英语的篇章结构特点和词汇特点，使学生在学完本教材之后能顺利进入更加专业的化学学习与研究中。

2.课文编排符合学生认知的习惯。教材设计上体现了学生作为学习主体的地位，每个单元都以一段汉语的导语来引进本单元的专业内容。各单元安排的专业课文由易到难，各项专业学习活动的前后都设计了学生互动的练习。教学设计突出任务型、互动型特点，避免教师进行按部就班、照本宣科式的教学。同时，每个单元的第3篇阅读课文还提供了汉语译文。

3.课文的组织实现了化学专业知识和英语语言学习的完美结合。本教材在实现专业课文和英语语言的知识与能力项目循序渐进、逐步展开的同时，注意了专业与语言学习的互相融合。在各单元的专业内容理解练习中渗透英语语言的知识训练，在英语词汇和语法的学习训练中，也紧密联系课文中的相关

专业内容。

本教材在教学方式上，给出以下的建议：

1.以互动形式的热身(Warming Up)开展每一项内容的教学。互动与合作是当前教学思想的主要亮点。学生对新内容的短小互动学习，既有利于渐进深入知识内容，又使得学生保持良好的精神状态，为后续活动做好准备。

2.根据认知科学的一般原理，学生对相关的背景了解越多，就越容易理解和掌握新的知识。因此，老师们在各篇课文备课时，可以根据需要自行补充必要的背景材料，在教学中也要充分调动学生已有的相关知识和经验。

3.为便于学生学习和巩固基本英语语法知识，本教材设置了词汇与翻译等语言练习。需要指出的是，这些练习的答案并非是绝对的、唯一的。在介绍练习和练习讲评时，要引导学生认识语境对于词汇选择和翻译处理的重要意义。

限于编者水平，本教材若有不足之处，欢迎使用本教材的广大师生多提宝贵意见，以便进一步修订完善。

编　者

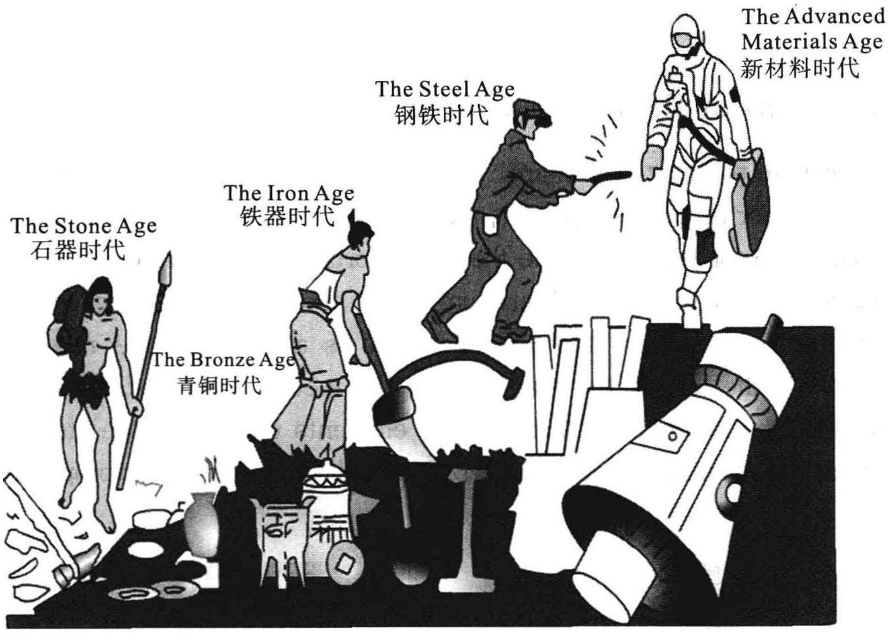
2011年6月

Contents

Unit 1 What is Chemistry?

导 语

自从有了人类,化学便与人类结下不解之缘。钻木取火、用火烧煮食物、烧制陶器、冶炼青铜器和铁器,等等,正是这些化学技术的应用极大地促进了当时社会生产力的发展,成为人类进步的标志。今天,化学作为一门基础学科,在科学技术和社会生活的方方面面正起着越来越大的作用。本单元介绍化学的发展历程。



Warming Up

In 1869, Russian chemist Dimitri Mendeleev started the development of the elements, arranging chemical elements by atomic mass. He predicted the discovery of other elements, and left spaces open in his periodic table for them.

"As long as chemistry is studied, there will be a periodic table. And even if someday we communicate with another part of the universe, we can be sure that one thing that both cultures will have in common is an ordered system of the elements that will be instantly recognizable by both intelligent life forms."

J. Emsley, *The Elements*

Oral work

1. Discuss in groups of four and then share in the whole class: how can the periodic table help us quickly determine electron configurations and quantum numbers?

2. Tell your friends at least one example of using the periodic table to predict certain characteristics of elements.

Text 1 The Periodic Table and Periodic Properties

The Anatomy of the Periodic Table

As you are probably well aware, in the periodic table (Fig. 1.1), elements are arranged in order of increasing atomic number. The 18 vertical columns of the table are called groups or families, while the seven horizontal rows are called periods and correspond to the seven principal quantum energy levels, $n=1$ through $n=7$.

On the right side of the periodic table is a dividing line resembling a staircase. To the left of the staircase lie the metals, and to the right of the staircase lie the nonmetals. Many of the elements that touch the staircase are called metalloids, and these exhibit are both metallic and nonmetallic properties.

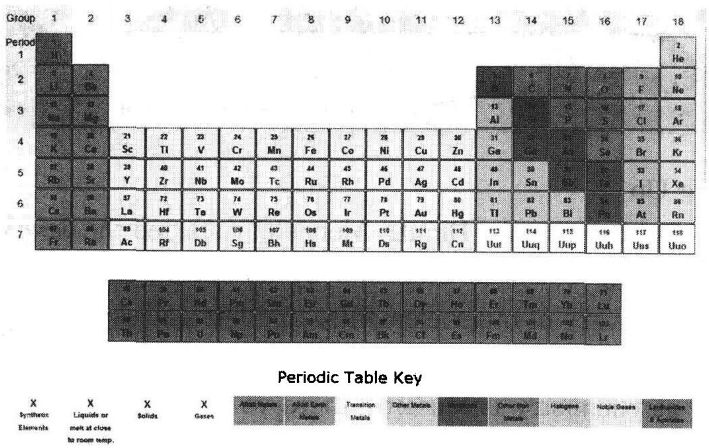


Fig. 1.1

Now that you're familiar with the different groupings of the periodic table, it's time to talk about the ways we can use the periodic table to predict certain characteristics of elements.

Atomic Radius

Since in an atom there is no clear boundary beyond which the electron never strays, the way atomic radius is measured by calculating the distance between the two nuclei of atoms when they are involved in a chemical bond. If the two bonded atoms are of the same element, you can divide the distance by 2 to get the atom's radius. Atomic radii decrease moving across a period from left to right. But why? It seems as though the more protons you add, the more space the atom should take up. But this is not the case. The reason for this lies in the basic concept that opposite charges attract each other and like charges repel each other. As you increase the number of protons in the nucleus of the atom, you increase the effective nuclear charge of the atom (Z_{eff}), and the nucleus pulls more strongly on the entire electron cloud. This makes the atomic radius decrease in size. The second thing you'll need to know is that atomic radii increase moving down a group or family. This is easier to understand if you refer to the Bohr model. As you move down the table, the value of n increases as we add another shell. Remember that the principal quantum number, n, determines the size of the atom. As we move down a family, the attractive force of the nucleus dissipates as the electrons spend more time farther from the nucleus.

Ionization Energy (IE)

The ionization energy of an atom is the energy required to remove an electron from the atom in the gas phase. Although removing the first electron from an atom requires energy, the removal of each subsequent electron requires even more energy. This means that the second IE is usually greater than the first one, the third IE is greater than the second one, and so forth. The reason why it becomes more difficult to remove additional electrons is that they're closer to the nucleus and thus held more strongly by the positive charge of the protons.

Ionization energies differ significantly, depending on the shell from which the electron is taken. For instance, it takes less energy to remove a p electron than an s electron, even less energy to extract a d electron, and the least energy to extract an f electron. As you can probably guess, this is because s electrons are held closer to the nucleus, while f electrons are far from the nucleus and less tightly held. You'll need to remember two important facts about ionization energy for the test. The first is that ionization energy increases as we move across a period.

The reason for this as is the case with periodic trends in atomic radii, is that as the nucleus becomes more positive, the effective nuclear charge increases its pull on the electrons and it becomes more difficult to remove an electron.

The second thing you'll need to remember is that ionization energy decreases as you move down a group or a family. The increased distance between electrons and the nucleus and increased shielding by a full principal energy level means that it requires less energy to remove an electron. Shielding occurs when the inner electrons in an atom shield the outer electrons from the full charge of the nucleus. Here are the values for the first ionization energies for some elements (Fig. 1.2).

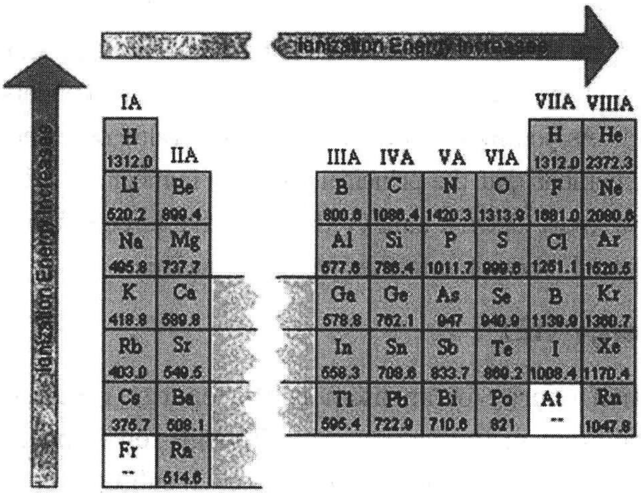


Fig. 1.2

Electron Affinity

An atom's electron affinity is the amount of energy released when an electron is added to the atom in its gaseous state—when an electron is added to an atom, the atom forms a negative ion. Most often, energy is released as an electron is added to an atom, and the greater the attraction between the atom and the electron added, the more negative the atom's electron affinity.

Electronegativity

Electronegativity is a measurement of the attraction an atom has for electrons when it is involved in a chemical bond. Elements that have high ionization energy and high electron affinity will also have high electronegativity since their nuclei strongly attract electrons. Electronegativity increases from left to right as we move across a period and decreases as we move down any group or family (Fig. 1.3).

By now, these trends should make sense. You know that ionization energies tend to decrease with increasing atomic number in a group, although there isn't a significant change in electron affinity so it makes sense that atoms' attraction for electrons in a bond would also increase as their Z_{eff} increased. We will discuss the concept of electronegativity further in the next section, when we discuss chemical bonding. Here's a summary of the trends we discussed in this section.

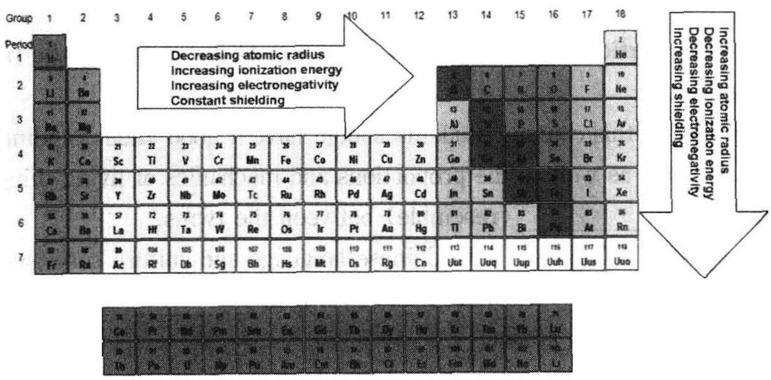


Fig. 1.3

Vocabulary

transition metals 过渡元素
rare earth elements 稀土元素
alkali metals 碱金属
alkaline earth metals 碱土金属
atomic radius 原子半径
effective nuclear charge 有效核电荷
cation /'kætaiən/ 阳离子
anion/'ænaiən/ 阴离子
ionization energy (IE) 电离能
shielding/'ʃiːldiŋ/ 电子屏蔽

electron affinity　电子亲和力
electronegativity/iˌlektrəuˈnegətiviti/　电负性
quantum/ˈkwɔntəm/　量子
energy levels　能级
proton/ˈprəutɔn/　质子
effective nuclear charge　有效核电荷(Z_{eff})
Bohr Model　玻尔模型

Understanding

Make a distinction or try to answer the following questions.

1. Which ion is larger, F^- or O^{2-}?
2. Which of the following elements has the highest ionization energy: K, Ca, Ga, As or Se?
3. Why do electron affinities not change very much as you go down a group?
4. The concept that opposite charges attracts each other and like charges repels each other is true in chemistry, but is it still true in real life? Discuss with your partners, providing the reasons and examples.

Vocabulary Learning

Ⅰ. Word Derivation: choosing the right form of the words in the brackets to fill in the blanks.

1. After finishing this course, students should have a good understanding of human ________(anatomy) as well as the proportions and mechanics of living things.
2. There's little ________(resemble) between the twins.
3. His ________(familiar) with Chinese language and culture surprised me.
4. When the electrons fly away from the hydrogen ________(nucleus), they are attracted towards the oxygen atoms.
5. In many senses, nuclear energy is clean. It does not produce ________(gas) emissions such as greenhouse gases, which are harmful either to the population and to the environment.

Ⅱ. Word Choice: using the words in the following box to fill in the blanks, changing the form of the words if necessary.

stray	involve in	take up	effective	refer to	dissipate	affinity
make sense	correspond to	boundary	familiar	predict		

1. "If we leave them alone and do not hold any celebration, their minds might ________ and be taken in by doomsday soothsayers and Y2K nuts."

2. Since they' ve got to pay his bill. They decided to __________ a collection and hold a bake sale.

3. People often __________ the signs and to the influence they are supposed to have on somebody's personality and fate.

4. The government has taken __________ measures to keep prices down.

5. She felt an __________ with all who suffered; their pains were her pains.

Ⅲ. Sentence Completion: study the following models and use them to make new sentences.

Example A *The more she called her husband a wimp, ...*

The more she called her husband a wimp, the more timid he became.

1. The more detailed the impression, ...
2. The more conservative your field is, ...
3. But to get along with children, the more strict you are, ...
4. The more you rich, ...
5. The sooner you start, ...

Example B *You are a college student; you should learn to be independent of your parents' help.*

Now that you are a college student, you should learn to be independent of your parents' help.

1. I've paid the tax demand and the children's school fees. I'll be head-over-heels in debt for the next six months.
2. She has a job in France. She can gratify her desire to see Europe.
3. Prices are rising so fast. All my money is draining away.
4. I am free. I can enjoy music for a while.
5. She is much more mobile. She has a car.

Ⅳ. Prefix Learning: "electro" as a useful prefix, means "involving electricity". For example "electromotive" 电动的;"electoculture" 电气栽培. Now talking with your partners and trying to find the meaning of the following words.

1. electrochemistry
2. electromagnet(ic)
3. electroplate
4. electrode
5. electron
6. electrolysis

Text 2　Borates in Industrial Use

Boron finds use in a wide range of industrial applications, the vast majority of which involve boron-oxygen compounds. This class exhibits a rich structural chemistry, featuring both crystalline and non-crystalline solids of industrial importance, and complex solution chemistry. The full extent of the role of boron as an essential element in fundamental life processes has only become clear during the past decade. The emerging biological roles of boron are relevant to both the commercial and environmental aspects of boron science. Although boron-oxygen chemistry is diverse and complex, it is ultimately based on the electrophilic character of trivalent boron. This review explores the chemistry of boron as it relates to its large-scale technological roles.

Although boron has a relatively low natural abundance (ca. 0.001% of the earth's crust), it is widely dispersed in the environment occurring in rocks, soils and natural waters at low but significant levels. Owing to boron's unique properties, it is more susceptible to fractionation by geological processes and can become concentrated to a greater extent than other elements of similar natural abundance. With the exception of a few rare fluoride minerals, boron always occurs on the earth in combination with oxygen, either in crystalline borate minerals or in water, primarily in the form of naturally occurring boric acid, $B(OH)_3$. Boron is found in sea water at an average level of 4.6 ppm. This level is too low to permit economical extraction of industrial quantities. Thus, commercial supplies of boron are derived from mineral deposits, which are found as alkali or alkaline earthmetal borates and borosilicates, with sodium and calcium borates being the most important. Although borate minerals are numerous, large commercially exploitable borate ore deposits are rare. However, when such deposits occur they can be vast. Owing to the relatively high water solubilities of borate minerals, these deposits are always found in arid regions. Most borates are produced in California and Turkey, with the rest coming from Russia, China, and the Andean regions of South America.

An estimated 1.25×10^6 metric tons of B_2O_3 is currently consumed annually in the form of the various borate products. Fig. 1.4 shows the approximate proportions of boron consumed by various large industries. It is notable that the use of borates in the manufacture of various types of vitreous materials, particularly berglass, ceramic glazes, and specialty borosilicate glasses, accounts for more than half of all boron used by industry. The uses of borates in peroxygen bleaching systems for household laundry detergents, micronutrient fertilizers, cellulose insulation (fire retardant), and cleaning products are also important. Following these applications, there are hundreds of other minor uses of borates, a small selection of which are listed in Table 1.1.

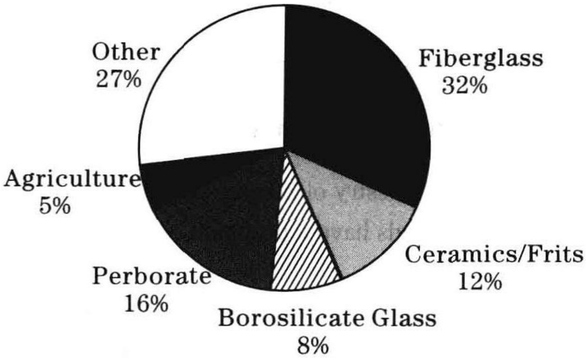


Fig. 1.4 Estimated total borate use by major industrial applications in B_2O_3 equivalents for the year 2001

Table 1.1 Examples of miscellaneous uses of borates

Adhesives	Capacitors	Nylon production (catalysis)
Automotive coolants	Fire retardants	Pharmaceuticals
Biocides	Fuel additives	Photography
Boron hydrides	Iron and steel production	Magnets
Brake fluids	Leather tanning	Metal working fluids
Buffers	Lubricants	Solders
Cement (set retardant)	Metallic glasses	Textiles
Cleaning products	Metal refining	Waxes/polishes
Corrosion inhibitors	Non-oxide ceramics	Water treatment
Cosmetics/lotions	Nuclear industry	Wire drawing

For the most part, other applications utilize boron oxides, but a small fraction of uses involves non-oxide materials such as boron hydrides and engineering ceramics. Although these non-oxide materials have received great attention in academic circles in recent decades, they are yet to gain much industrial significance in the overall scheme of the borate industry.