普通高等教育“十三五”规划教材

化学与应用化学专业英语（第二版）

PROFESSIONAL ENGLISH IN CHEMISTRY AND APPLIED CHEMISTRY（SECOND EDITION）

王幸宜　戴启广　马海燕　詹望成 / 编 著

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内容提要

《化学与应用化学专业英语(第二版)》是根据大学英语教学大纲的专业阅读部分的要求而编写的,旨在为化学、应用化学提供一本比较系统的专业英语教学用书。本书的第一版作为科技英语教材,已在多个大专院校化学与应用化学专业使用多年。本版进行一些必要的减缩,在内容上更紧凑、精炼。

本书共分为8个单元,内容涵盖综合化学、无机化学、有机化学、物理化学、分析化学、生物化学、材料科学和单元操作,每课由Paper、New Words and Expressions、Notes、Further Reading和Solved Problem 5个部分组成。与比第一版相比,删除了Words to Know、Supplementary Reading和Practical Reading 3个部分。

书后还附录了化学元素名称中英文对照表、化学专业英语词汇常用前后缀。另外,为了方便学生的查阅,本书还附有课文生词表。

本书可供化学、应用化学专业本科生专业英语教学或双语教学使用。

第二版前言

高等学校理工科本科生的《大学英语教学大纲》中规定，在大学英语基础阶段学习后，从第五学期起要开设必修的专业阅读课。基础英语是专业英语的基础，但专业英语在词汇、语法、句法及文风等诸方面又带有各自专业的特色。为了使学生毕业后能够更快和更有效地应用英语这一工具为自己的专业服务，在授完基础英语课程之后，开设相应的专业英语课程是非常有必要的。

本书第一版采用近期经典英文原版化学书籍，摘录重要片段，从纵、横两个方面覆盖化学及应用化学专业的相关内容。第二版是在其第一版多年教学的基础上，听取了任课教师和同学的意见，进行了必要的缩编，旨在教学过程中，使学生能更深入、更集中地掌握和阅读与化学紧密相关的词汇、化学概念和化学过程的表达方法，还能在科技英语实际应用能力方面包括文献阅读、科技英语写作等得到系统的训练。

编　者

2016 年 6 月

前　　言

随着中国改革开放、加入世贸以及市场经济的发展，不管是企业中的业务推广、谈判还是科研机构中的技术研发，同国外的科技交流与合作日趋增多，因此对既懂专业知识又懂英语的人才需求量日益提高。为了适应这种形势的发展需要，有必要加强化学专业英语的教育，提高在校本科生、研究生以及相关人员的英语水平。因而，化学专业英语成为国内各高等院校化学、应用化学及相关专业的一门专业必修课。

本书共分为8个单元，内容涵盖综合化学、无机化学、有机化学、物理化学、分析化学、生物化学、材料科学、单元操作、科技文献，除综合化学和科技文献两单元外，每单元均由数量不等、选自国外原版英文书籍的相关文章组成，每课由以下5个部分组成：Paper、New Words and Expressions、Notes、Further Reading、Solved Problems。其中，综合化学单元作为基础介绍篇，其目的在于为读者提供对化学学科的基础认识，包括两篇文章，分别描述了化学学科的基础以及化学学科的展望；科技文献单元作为提高篇，主要针对有意进入研究生阶段学习的本科生，目的在于为读者提供科技文献阅读和写作相关的基础知识，教师在讲授过程中可将此单元作为自学篇。其他单元课文选材广泛，对化学及其相关交叉学科进行了基础而全面的介绍，内容由浅入深。

本书每单元组成部分的内容安排有如下特色。

(1) Notes，注重对化学问题的注释。减少对英语语法本身的注释，突出科技英语的特点。

(2) Further Reading，深入阅读。对正文某个具体问题或某个概念进行深入介绍，使读者能够以英语的思维方式对正文所涉及的化学知识有进一步的认识。

(3) Solved Problems，课后习题。习题大多数来自英文原版教材。此部分让读者结合专业课程的学习，用英文作解答问题练习(如概念问答、解释题型需采用英文作答)。

本书中所有课文全部选自国外英文原版书籍，内容新颖，难易适中。为了教学需要，编者对课文原文进行了部分删节和编辑。书后还附录如下内容：化学元素名称中英文对照表；化学专业英语词汇常用前后缀；化学常见缩略语；化学实验室常用仪器名称；常用英文化学分子式、方程式及数学式的读法。另外，为了便于读者的查阅，本书还附有课文生词表。

本书可供化学及应用化学专业本科生的化学专业英语教学或双语教学，也可以作为相关专业的研究生、教师以及从事轻化工及相关专业的科技人员的参考用书。

本书编写过程中，我们参阅了大量国外书籍和文献(参考文献中均一一列出)，在此向这

些书籍和文献的原作(编)者致以诚挚的谢意。另外,有些资料来自网络而无法确定原作者,在此编者也表示真诚的感谢,若涉及版权问题,请与出版社或编者联系。

由于编者水平和编写时间有限,书中不足之处在所难免,敬请读者予以批评指正。

目　录

Unit One

General Chemistry

Lesson One

Chemistry Today and Tomorrow: the Central, Useful and Creative Science

Ronald Breslow

What is chemistry?

Chemistry is the 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.

What do chemists do?

As the quotation at the head of this article 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.

What was some of the earliest chemistry?

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, then 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.

When wood is heated it loses water and produces charcoal. In this process the **cellulose** of wood 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, while 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.

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.

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.

After the early period of random discovery, humans began heating substances together intentionally 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 carries 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.

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.

Why do chemists call their discipline the "central science"?

Chemistry touches many other scientific fields. It makes major contributions to agriculture, electronics, biology, medicine, environmental science, computer science, engineering, geology, physics, metallurgy and mineralogy, among many others. It does not ask the physicists' question: what is the ultimate nature of all matter? Instead it asks the chemists' questions: why do the substances of the world differ in their properties? how can we control and most effectively utilize these properties?

Interesting and exciting as the physics question is, answers to the chemists' questions allow us to create new medicines, make new materials for shelter and clothing and transportation, invent new ways to improve and protect our food supply, and improve our lives in many other ways as well. Thus we see chemistry as "central" to the human effort to move above the brutish existence of our caveman ancestors into a world where we can exist not only in harmony with nature, but also in harmony with our own aspirations.

What makes chemistry the "useful science" and the "creative science"?

The two questions are linked. Some chemists explore the natural world and find useful chemical substances not known before. This exploration has been carried out extensively by examining the chemicals found in plants and animals on land, and it still goes on. Now there is also a major search for new chemicals from plants and animals in the seas. Once these chemicals are isolated and their chemical structures are determined, the creativity of chemists takes over.

Normally we would not continue to harvest the living sources of useful new drugs, for instance this could be too destructive and too costly. Instead chemists devise ways to synthesize the newly discovered compounds, to create them from other simpler materials, so they can be readily available. Sometimes the original chemical structures are altered by creative synthesis, to see whether the properties of a novel relative of the natural compound are even better.

There is a reason that the search for useful natural chemicals often pays off. The natural world is not the peaceful place we dream and there are fierce battles for survival. Insects eat plants, and some plants have developed chemicals that will repel those insects. When we learn what those chemicals are, we can make them synthetically and use them to help protect our food plants. Bacteria can infect plants, animals, and other **microorganisms** such as yeasts and molds, not **just** humans. Some organisms have developed powerful **antibiotics** to protect themselves. Most of the effective antibiotics in human use have come from the exploration of nature's chemistry, although sometimes the medicines we use are versions improved by chemists.

The most creative act in chemistry is the design and creation of new molecules. How is this done? New chemicals used to be made by what chemists irreverently refer to as "shake and bake": heat up some mixture and see what happens, as in the earlier examples of making metals and glass. The alchemists of the past devoted themselves to heating up various mixtures in the vain hope to turn lead into gold. They did not succeed, but they did create some interesting new chemical processes and new substances.

Syntheses are now normally designed using the fundamental principles that chemists have discovered. As many as 30 or more predicted chemical steps are sometimes needed, in a sequence, to permit the synthesis of a complicated molecule from available simple chemicals. This could not be done without a clear understanding of chemical principles.

What are some fundamental principles of chemistry?

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 periodic 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 an element appears that is similar in its properties to one that has occurred earlier in the table.

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.

There are some fundamental principles governing chemical reactions, by which molecules change into other molecules. One principle is that such changes will not occur if the products of the reactions would be much less stable (have higher energy) than the starting materials. Just as rocks roll downhill but not uphill, chemical reactions spontaneously roll "downhill" to lower energy states. (Energy is not the only consideration, since chemical reactions also go in directions to maximize disorder, which is called entropy by chemists. A simple analogy is that shuffling a new deck of cards tends to put them into random arrangements, and further shuffling does not put them back into order again.)

Another principle is that even favorable reactions, whose products are lower in energy or more disordered than the starting materials, do not necessarily occur rapidly. This is a good thing the burning up of all living things by reaction with the oxygen of the air is a favorable process energetically, but luckily it does not happen readily unless the temperature is very high, as in a flame.

This final example reflects a related principle: even reactions that end up with low-energy products need some extra energy to pass through intermediate stages that are not stable. A good analogy would be taking a trip from Denver to San Francisco. The overall trip is downhill from Denver at 5 000 feet to San Francisco at sea level, but extra energy is needed to get over the mountain ranges along the way. The extra energy for chemistry needed to climb such "mountain ranges" along the way is available at high temperature, so most chemical reactions speed up when they are heated. Catalysts find another way to speed up favorable reactions.

The Future

Human needs for new chemistry are as great as ever. We need and will create new drugs to fight diseases such as cancer, acquired immunodeficiency syndrome (AIDS), Alzheimer's disease, heart disease, and stroke that shorten our lives or diminish their quality. We will invent new ways to generate and store energy. Methods to isolate and concentrate the radioactive products from nuclear reactors will make nuclear energy much more acceptable. Methods to store electric vehicles that are superior to and cleaner than the current gasoline models. New manufacturing processes will help us make the materials we need while protecting our environment.

We will improve computational chemistry to the point at which we can predict which new molecule to make for some desired properties, and determine how to make it. We will move from studying the properties of isolated molecules to fully understanding the properties of organized chemical systems, as in a living cell. We will learn how to make **catalysts** for our own needs that equal or exceed the natural **enzymes** in their effectiveness and selectivity. This will make it possible to carry out chemical manufacturing without using energy for high temperatures to speed up reactions, and without making the unwanted side products that result when reactions are not sufficiently selective.

This future depends on participation by future generations of chemists, the students of today, and support by the rest of society. However, there is one prediction we can make with assurance: some wonderful new things will be created or discovered that we have not even anticipated. Science, including chemistry, is constantly surprising us, and this will surely continue. As the physicist Leo Szilard said, "Prediction is difficult, especially of the future."

Selected from Chemistry today and tomorrow: the central, useful, and creative science, by Ronald Breslow, Jones & Bartlett Publishers, Inc., 1997.

Words and Expressions

dye	[daɪ]	*n.*	染料，染色
soap	[səʊp]	*n.*	肥皂
charcoal	[ˈtʃɑːkəʊl]	*n.*	木炭，活性炭
cellulose	[ˈseljʊləʊs]	*n.*	纤维素
fat	[fæt]	*adj.*	肥胖的；*n.* 脂肪
alkali	[ˈælkəlaɪ]	*n.*	碱
fatty acid			脂肪酸
glycerin	[ˈglɪsərɪn]	*n.*	甘油
iron ore			铁矿
coke	[kəʊk]	*n.*	焦炭
coal	[kəʊl]	*n.*	煤
carbon monoxide			一氧化碳
bacteria	[bækˈtɪərɪə]	*n.*	细菌
microorganism	[maɪkrəʊˈɔːgənɪz(ə)m]	*n.*	微生物
antibiotics	[ˌæntɪbaɪˈɒtɪks]	*n.*	抗生素，抗生素工艺学
alchemist	[ˈælkɪmɪst]	*n.*	炼金术士
covalent	[kəʊˈveɪlənt]	*adj.*	共有原子价的，共价的
ionic bond			离子键
catalyst	[ˈkætəlɪst]	*n.*	催化剂
enzyme	[ˈenzaɪm]	*n.*	酶

Lesson Two

Frontiers in Chemistry

B. Viswanathan

1. Introduction

The study of chemistry is changing its face. In 20th century, the study of chemistry required some foundations in mathematics. But as the 21st century is unfolding, the emphasis in chemistry is shifted to biology. In fact, the demarcation line that existed between chemistry and biology is slowly vanishing and now one either talks of **chemical biology** or **biological chemistry**. This change over is going to have many ramifications in the study of chemistry. This shift in emphasis will have many other consequences. Some of the changes that one can expect in the study of chemistry would be that the study of atoms and molecules and **clusters** will become routine and mapping of the **wave functions** will become possible and hence the chemical reactivity will become a predictable parameter.

The consequence of the overlap of chemistry with biology will manifest remarkably in our study of the energy conversion processes. Hitherto the energy conversion processes are governed by the **Carnot limitation** since the known and practiced energy conversion processes always involved thermal conversion in one step or other. As all of us know that thermal route for energy conversion is the least efficient one. Living systems as well as the individual components of living systems function with internal generation of energy. Internal generation of energy probably accounts for high efficiency. Chemists have to formulate energy conversion devices as efficient as the living systems and probably this will be one way of understanding life.

The chemical industry has been toying with the idea of achieving 100% selectivity and the possibility of by-product formation has been one of the stumbling blocks for this goal. This has resulted in desire for 100% **atom economy** and hence led to the concept of **green chemistry**. Chemical industries have to change their raw material inventory and hence the process principles also have to be changed considerably.

Synthetic chemistry is the corner stone of chemical industry. Synthetic methodologies have to be changed alternate media, (**ionic liquids**) reaction conditions (high temperature and pressure) have to be room temperature and atm pressure. This means that the basic