全国高职高专教育“十一五”规划教材

侯 侠 主编

化工专业英语

高等教育出版社
HIGHER EDUCATION PRESS

化工专业英语

全国高职高专教育"十一五"规划教材

化工专业英语

侯　侠　主编

高等教育出版社

内容提要

本书是根据最新高等职业教育化工技术类专业人才培养目标编写的。全书共分为17个单元，每个单元都由精读部分和泛读部分组成。主要内容包括：基础化学、化工单元操作过程、炼油技术、无机化工、有机化工、精细化工、高分子化工、生物化工、清洁生产等。同时，为了提高学生阅读能力，将基础知识与工程实际相结合，还特意编进了一些产品和设备的说明书、设备的安装说明书。附录中设有数学符号表、常用有机基团名称表、化学元素表、单词表等。

本书适用于应用性、技能型人才培养的各类教育，也可供相关科技人员参考。

图书在版编目(CIP)数据

化工专业英语/侯侠主编. —北京：高等教育出版社，2007.3

ISBN 978-7-04-020803-0

Ⅰ.化… Ⅱ.侯… Ⅲ.化学工业-英语-高等学校：技术学校-教材 Ⅳ.H31

中国版本图书馆CIP数据核字(2007)第027806号

策划编辑 王 冰 **责任编辑** 刘 佳 **封面设计** 于 涛 **责任绘图** 朱 静
版式设计 王艳红 **责任校对** 杨雪莲 **责任印制** 尤 静

出版发行	高等教育出版社	**购书热线**	010－58581118
社　　址	北京市西城区德外大街4号	**免费咨询**	800－810－0598
邮政编码	100011	**网　　址**	http://www.hep.edu.cn
总　　机	010－58581000		http://www.hep.com.cn
		网上订购	http://www.landraco.com
经　　销	蓝色畅想图书发行有限公司		http://www.landraco.com.cn
印　　刷	化学工业出版社印刷厂	**畅想教育**	http://www.widedu.com
开　　本	787×1092 1/16	**版　　次**	2007年3月第1版
印　　张	12.25	**印　　次**	2007年3月第1次印刷
字　　数	280 000	**定　　价**	17.70元

物料号 20803－00

高等职业教育化学化工类专业系列教材编审委员会

前　言

本书是根据最新高等职业教育化工技术类专业人才培养目标而编写的。“化工专业英语”作为高职高专相关专业人才培养的一门专业必修课程，其任务是通过本门课程的学习使学生能够掌握化工专业英语词汇及术语，初步具备专业英语的翻译及写作能力；同时通过本专业英语的学习，获取新的信息，进一步了解国内外化工专业的发展方向。

全书共分为 17 个单元。其中第 1、第 2 单元介绍了基础化学中的一些知识。第 3 至第 7 单元介绍了基本化工单元操作过程，第 8 至第 14 单元分别较详细地介绍了炼油生产、有机化工、无机化工、精细化工、高分子化工、生物化工、清洁生产相关的基础理论、生产技术和最新发展等。第 15 单元介绍了计算机和化学工程的关系及应用。本书最后两个单元介绍了一些产品和原料的说明书及设备的操作指导书，作为学生应用能力提高的阅读材料。本书每单元的内容都可分为两部分：精读部分和泛读部分。精读部分作为基本要求，通过课堂讲解要求学生参考注释将全文译成汉语，译文正确，基本通顺达意。泛读部分作为较高要求为学生提供了更广阔的阅读空间。书后附录包括数学符号表、常用有机基名表、化学元素表、单词表等。

本书由兰州石化职业技术学院侯侠担任主编并编写第 1 至第 8 单元、第 12、第 13 单元；石家庄职业技术学院陈玉峰编写第 9 至第 11 单元、第 14 单元；兰州石化职业技术学院王鹏编写第 15 至第 17 单元及附录一、二、三、四；全书由侯侠统稿。本书由北京化工大学孙巍教授担任主审，承德石油高等专科学校曹克广教授也参与了审定工作，提出了宝贵的修改意见，教育部高等学校高职高专化工技术类专业教学指导委员会、中国职业技术教育学会教学工作委员会化学教学研究会（高职）给予了指导和帮助在此一并表示感谢。

由于编者水平有限，时间有限，书中疏漏之处在所难免，欢迎老师和读者批评指正。

编者

2006 年 9 月

Contents

Lesson 1 Atomic structure

The aim of knowledge:

- Knowing the composition of atoms;
- Understanding the Bohr atomic model;
- Mastering the methods of describing an atom and some important words of atomic structure

The aim of ability:

- Be able to describe the atomic structure

Atoms consist of a dense, positively charged *nucleus* surrounded at a relatively large distance by negatively charged *electrons*. The nucleus consists of subatomic called neutrons, which are electrically neutral and protons which are positively charged. Though extremely small—about 10^{-4} to 10^{-15} meter (m) in diameter, the nucleus nevertheless contains essentially all the mass of the atom. Electrons have negligible mass and orbit the nucleus at a distance of approximately 10^{-10} m, thus, the diameter of a typical atom is about 2×10^{-10} m, or 2 angstroms(Å), where 1 Å$=10^{-10}$ m. To give you an idea how small this is, a thin pencil line is about 3 million carbon atoms wide.

An atom is described by its **atomic number(*Z*)**, which gives the number of protons in the atom's nucleus, and its **mass number(*A*)**, which gives the total of protons plus neutrons. All the atoms of a given element have the same atomic number—1 for hydrogen, 6 for carbon, 17 for chlorine, and so on, but they can have different mass numbers depending on how many neutrons they contain. The average mass number of a great many atoms of an element is called the element's **atomic weight**—for hydrogen, 12.011 for carbon, 35.453 for chlorine, and so on.

One early outgrowth of quantum mechanics was the simplified **Bohr atomic model** (Fig 1). The **Bohr model** represents the atomic energy levels with discrete levels much like the orbits of planets around the sun. A more complete picture of the electrons would show them as probability clouds where the 'orbit' is merely the most likely distance from the nucleus. For most purposes of chemistry and materials sci-

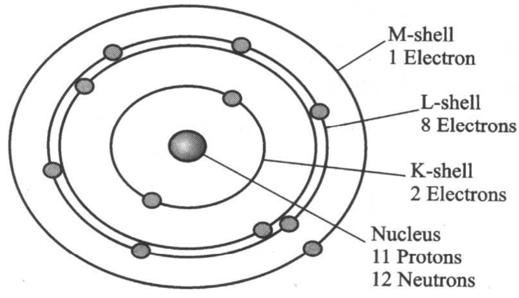

Fig 1 The Bohr atomic structure—Na

ence, this quantum-mechanical view of the atom is not necessary, and the simple orbital model with its discrete energy levels is quite adequate.

The complete description of the electron arrangement around an atom is given by a series of numbers that describe the shell('orbit') and the number of electrons in the shell. The filling of the shells is based on quantum number and energy levels.

Thus, iron (atomic number 26) is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$ meaning that there are 2 electrons in the first shell (in the s level), a total of 8 electrons in the second shell (2 in the **s**, 6 in the **p** level) a total of 14 electrons in the third shell (2 in the **s**, 6 in the **p**, 6 in the **d**) and 2 electrons in the fourth shell (in the **s** level).

Two illustrations of the sequence of atoms in the periodic table are shown in Fig 2. One shows the approximate energy levels of the various shells, indicating why, for instance, there are electrons in the 4s level before the 3d level is filled. The second shows the same sequence emphasizing the fact that there are pairs of electrons in each shell and level, with opposite spins.

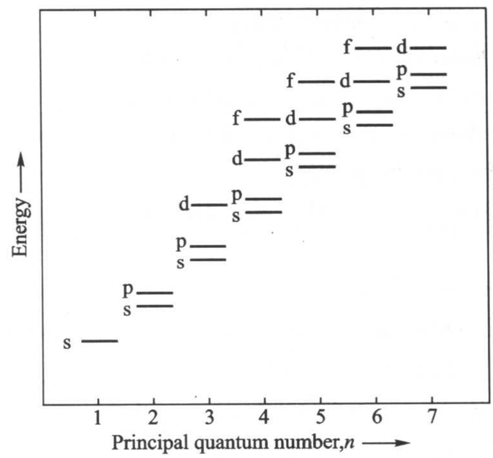

Fig 2 Schematic representation of the relative energies of the electrons for the various shells and subshells

New Words

1. atom [ˈætəm] n. 原子
2. dense [ˈdens] adj. 浓密的，稠密的
3. positively [ˈpɔzətivli] adv. 带正电地
4. nucleus [ˈnjuːkliəs] n. 核；核心；原子核
5. negatively [ˈnegətivli] adv. 带负电地
6. electron [iˈlektrɔn] n. 电子
7. subatomic [ˌsubəˈtɔmik] adj. 次原子的，比原子小的；在原子内的
8. neutron [ˈnjuːtrɔn] n. 中子
9. diameter [daiˈæmitə(r)] n. 直径
10. essentially [iˈsenʃəli] n. 本质上；本来；根本
11. negligible [ˈneglidʒəbl] adj. 可以忽视的；很小的，微不足道的
12. orbit [ˈɔːbit] vt/vi. 环绕(天体等)作轨道运行；n. 轨道

13. proton [ˈprəutɔn] n. (正)质子;氕核
14. neutral [ˈnjuːtrəl] adj. 【化、电】中性的;中和的;不带电的
15. charge [tʃaːdʒ] vt. 填;装(子弹);充(电);使饱和;使充满;堆积,装载
16. nevertheless [ˌnevəðəˈles] adv. 仍然(还),不过
17. outgrowth [ˈautgrəuθ] n. (自然的)结果;派生物;副产物
18. quantum [ˈkwɔntəm] n. 【物理学】量子
19. discrete [diˈskriːt] adj. 不连续的
20. adequate [ˈædikwit] adj. 适当的;足够的,充分的
21. iron [aiən] n. 铁
22. shell [ʃel] n. 壳;介壳;甲壳;贝
23. illustration [iləˈstreiʃən] n. 说明,例证,实例;图解,插画
24. opposite [ˈɔpəzit] adj. 相对的,对立的;正相反的,敌对的;不相容的
25. spin [spin] n. 旋转

Expressions and Technical Terms

1. atomic structure 原子结构
2. consist of 由……组成
3. atomic number 原子序数
4. mass number 质量数
5. atomic weight 原子量[①]
6. Bohr atomic model 玻尔原子结构
7. atomic energy level 原子能级
8. the periodic table 元素周期表

Notes

1. The nucleus consists of subatomic called neutrons, which are electrically neutral and protons which are positively charged. 原子是由不带电的中子和带正电的质子所组成的。which are electrically neutral 是定语从句修饰 neutrons, which are positively charged 是定语从句修饰 protons。
2. Electrons have negligible mass and orbit the nucleus at a distance of approximately 10^{-10} m, thus, the diameter of a typical atom is about 2×10^{-10} m, or 2 angstroms(Å), where 1 Å $=10^{-10}$ m. 电子的质量很小,它绕原子核的轨道直径大约在 10^{-10} m 左右,一个典型原子的直径大约在 2×10^{-10} m,或 2 埃(1 Å $=10^{-10}$ m), where 1 Å$=10^{-10}$ m. 是定语从句修饰 angstroms。
3. All the atoms of a given element have the same atomic number—1 for hydrogen, 6 for car-

① 国家标准称相对原子质量(relative atomic mass)。

bon, 17 for chlorine, and so on, but they can have different mass numbers depending on how many neutrons they contain. 对于一个给定的元素,所有的原子都有相同的原子序数——如氢元素的原子序数为1,碳元素的原子序数为6,氯元素的原子序数为17,等等;但他们各自都有不同的质量数。因为,质量数是由原子所含的中子数决定的(对于原子序数相同的元素而言,质子数是相同的)。depending on…they contain 为现在分词作后置定语修饰 mass numbers。

4. The complete description of the electron arrangement around an atom is given by a series of numbers that describe the shell("orbit") and the number of electrons in the shell. 原子中的电子排列可以用数字来表示,这组数字用来描述轨道的电子层数和电子层中的电子数。that describe…the shell 为定语从句修饰 numbers。
5. One shows the approximate energy levels of the various shells, indicating why, for instance, there are electrons in the 4s level before the 3d level is filled. 其中一种解释显示了不同电子层的大致的能量级,这种能量级可以解释如电子先进入 4 s 轨道而非 3 d 轨道的原因。indicating…are filled 是现在分词作后置定语修饰 energy levels,其中,why…are filled 是原因状语从句。

Exercises

1. Put the following into Chinese
   (1) Atoms consist of a dense, positively charged *nucleus* surrounded at a relatively large distance by negatively charged *electrons*.
   (2) An atom is described by its **atomic number(Z)**, which gives the number of protons in the atom's nucleus, and its **mass number(A)**, which gives the total of protons plus neutrons.
2. Put the following into English
   原子　电子　质子　原子核　质量数　原子序数　原子能级
3. Guided writing

Experimental description

This description of experimental process is a commonly used technique in EST. The description aims at telling the students the procedures of the experiment, thus the imperative mood is often used. Passive voice is typical in such writings, as what we want to describe is a thing. In the description, present tense is normally used to refer to present time. If you want to know what happened before, past tense is your choice to the exclusion of laws and truths.

Stage 1

Rewrite the following paragraph, pay special attention to the linguistic features of experimental description.

Close one end of a large glass tube with a stopper. You fill half of the tube with water. Carefully fill the rest of the tube with alcohol. We must be careful not to mix the liquid while filling the tube. Seal the open end with another stopper. The tube is tipped back and forth to mix the alcohol and water.

Stage 2

Write out the description to the Chinese given below.

用浓盐酸擦湿一只瓶子的内壁,倒掉多余的液体,用一片玻璃板盖上,再用浓氢氧化氨擦湿另一只瓶子的内壁,倒掉多余的液体,也用一片玻璃板盖上。将第二只瓶子倒转至第一只瓶子上面,使两块玻璃板接触在一起,抽掉两片玻璃板,在玻璃板相遇处生出白烟,白烟向下面瓶子同时也向上面的瓶子扩散。在气体相遇处生出的白烟就是氯化铵。

1 化工专业英语的特点

1.1 表达形式的特点

长句多,被动语态使用频繁,常用 It…句型结构,专业术语多,缩略词经常出现,插图、公式、数字所占比例大,合成新词多等。例如:

It should be made clear that the cumene route for the production of acetone is more complex but yields another important petrolchemical(phenal) as well as acetone and that benzene is alkylated with prepylene in the reaction in the same time:

$$C_6H_6 + CH_2 = CHCH_3 \longrightarrow C_6H_5CH(CH_3)_2$$

benezene propylene cumene

这是有关石油化工专业英语一个长句,采用 It…无人称句式和被动语态,句子长,信息量大,充分体现了化工专业英语中的四个特点,对石油化工专业知识了解甚少的人,阅读起来很困难。

1.2 语法特点

下面是关于水银测温仪测温度的两个长句:

For measuring temperatures below −40°F, thermometers filled with alcohol are used. Because of the low melting point of glass, it is limited to use these thermometers for temperatures as high as 1 000°F, as the rising of mercury and the increase of the gas pressure.

二句使用了被动语态和一般现在时,这在化工专业英语中极为常见。一方面被动语态句子允许将最重要的信息放在句首,比主动语态句子更直接明了;工程专业技术人员关心的是专业事实及行为而非行为者,上例中并未指出谁用水银测温仪测量,谁限定了测

温仪的极限,采用被动语态就避免了这种不必要的考证。正因此,被动语态广泛地应用于描述专业原理、过程等。就时态而言,化工专业所涉及的内容一般都没有特定的时间关系,所以常采用一般现在时,进一步突出了专业的客观性,本句亦是如此。

此外,精炼性(Conciseness)和准确性(Accuracy)也是化工专业英语的语法特点。化工专业英语总是希望用尽可能少的词汇来清晰地表达专业含义,这就导致了非限定动词及名词化词组的广泛采用。动名词短语可用来替代条件、时间、伴随状语从句,分词短语可用来取代关系从句,不定式短语可以替换目的状语从句,而名词词组则可以极大地简化句子;至于准确性,因为化工专业知识关注的是客观存在,本身就要求用词(尤其是数词)表达准确。这些都在上例中得到充分体现。

Reading material

Chemical bonding

The aim of knowledge:

- Knowing the kinds of chemical bonding;
- Understanding the type of all kinds of chemical bonding;
- Mastering the feature of all kinds of chemical bonding and some important words of chemical bonding

The aim of ability:

- Be able to describe the kinds and feature of chemical bonding in English

There are three principal kinds of bonds that form between atoms: metallic, ionic, covalent. It is the electronegativities of atoms that determine what bond type forms. If the atoms have high electronegativity, they share electrons in a **covalent bonding** between individual pairs of atoms. If the atoms have low electronegativity, they share electrons amongst all of the atoms in a **metallic bonding.** If some of the atoms have high and some low electronegativity, the electrons are transferred from one atom to another resulting in an **ionic bonding.**

The forces between atoms are electrostatic, and for the strong bonds depend directly on the electrons that surround the atoms. The different bond types are characterized by how electrons are shared, which controls the geometry of the atom packing, and by the relative strength of the bond (revealed in the temperature needed to melt the material and break the bonds).

Perhaps **ionic bonding** is the easiest to describe and visualize. It is always found in compounds that are composed of both metallic and nonmetallic element, elements that are situated at the horizontal extremities of the periodic table. Atoms of a metallic element easily give up their valence electrons to the nonmetallic atoms. In the process all the atoms acquire stable or inert gas configurations and, in addition, an electrical charge; that is, they become ions. Sodium chlorine(NaCl) is the classical ionic material. A sodium atom can assume the electron structure of neon(and a net single positive charge) by a transfer of its one valence 3s electron to a chlorine. After such a transfer, the chlorine ion has a net negative charge and an electron configuration identical to that of argon. In sodium chloride, all the sodium and chlorine exist as ions. This type of bonding is illustrated schematically in Fig 3.

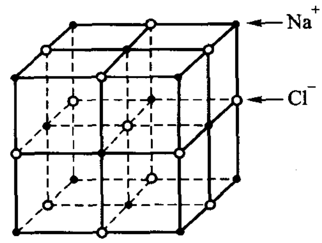

Fig 3 Schematic representation of ionic bonding in sodium chlorine(NaCl)

Many nonmetallic elemental molecules(H_2, Cl_2, F_2, etc.)as well as molecules containing dissimilar atom, such as CH_4, H_2O, HNO_3 and HF, are covalently bonded.

In covalent bonding stable electron configuration are assumed by the sharing of electrons between adjacent atoms. Two atoms that are covalently bonded will each contribute at least one electron to the bond, and the shared electrons may be considered to belong to both atoms. Covalent bonding is schematically illustrated in Fig 4 for a molecule of methane(CH_4).

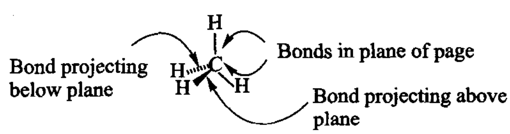

Fig 4 Schematic representation of covalent bonding in a molecule of methane(CH_4)

To describe any molecule we need to know the angles, lengths, and strength of all of its bonds. For methane these parameters are that H—C—H bond angle is 109°28′, C—H bond length is 0.11 nm, C—H bond strength is 104 kcal/mol①.

Metallic bonding is found in metals and their alloy. Metallic materials have one, two, or at most, three valence electrons, with this model; these valence electrons are not bound to any particular atom in the solid and are more or less free to drift throughout the entire metal. They may be though of as belonging to the metal as a whole, or forming a 'sea of electron' or an 'electron cloud'. The remaining non-valence electrons and atomic nucleus form what are called ion cores, which possess a net positive charge equal in magnitude to the total valence electron

① 1 kcal/mol=4.184 kJ/mol.

charge per atom. Fig 5 is a schematic illustration of metallic bonding.

Van der Waals bonding (secondary bonding) exists between virtually all atoms or molecular, but its presence may be obscured if any of the three primary bonding type is present. Secondary bonding is evidenced for the inert gases, which have stable electron structures, and in addition, between molecules in molecular structures that are covalently bonded.

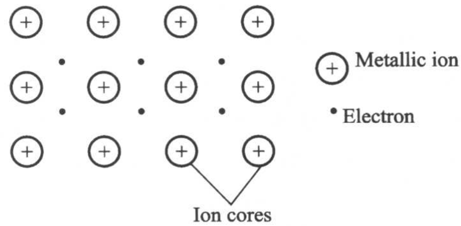

Fig 5 Schematic illustration of metallic bonding

New Words

1. bond [bɔnd] vt.【化学】以化学键使结合在分子[结晶体]内 n. 化学键
2. electronegativity adj.【物理学】负电性的，阴电性的
3. individual [ˌindiˈvidjuəl] adj. 单一的，个别的，单独的
4. amongst [əˈmʌŋst] adv. 前置词，在……中间
5. magnitude [ˈmægnitjuːd] n. 大小；积；量；【数学】量值
6. electrostatic [iˈlektrəustətik] adj. 静电的，静电学的
7. characterize [ˈkærəktəˌraiz] vt. 表示……的特性；以……为特性；使带有……的特征
8. geometry [dʒiˈɔmitri] n. 几何学；几何形状
9. visualize [ˈviʒuəlaiz] vt.（使）显现；想像；（使）形象化，（使）具体化
10. metallic [miˈtælik] adj. 金属的；金属性的，金属质的；金属制的
11. nonmetallic adj. 非金属的
12. extremity n. 末端，尽头；极端，极度
13. element [ˈelimənt] n.【化学】元素
14. configuration [kənˌfigjuˈreiʃən] n. 结构；外形；【化学】（分子中原子的）组态，排列
15. ion [ˈaiən] n.【物理学】离子
16. classical [ˈklæsikl] adj. 古典的，传统的，权威的，经典的
17. neon [ˈniɔn] n.【化学】氖〔元素名，符号为 Ne〕；氖光灯，霓虹灯
18. argon [ˈaːgən] n.【化学】氩〔元素名，符号为 Ar〕
19. illustrate [ˈiləstreit] vt.（用例子、图解等）说明；举例证明；加上插图[图解]
20. schematical [skiˈmætikl] adj. 要领的；纲要的；图解的，（按照）图式[公式]的
21. dissimilar [diˈsimilə] adj. 不同的，不一样的
22. adjacent [əˈdʒeisnt] adj. 毗邻的，邻近的
23. methane [ˈmiːθein] n.【化学】甲烷，沼气
24. alloy [ˈælɔi] n. 合金
25. valence [ˈveiləns] n.【化学】（化合）价；（原子）价

26. virtually [ˈvəːtuəli] adv. 实际上,实质上,事实上
27. obscure [əbˈskjuə] vi. 变模糊;隐藏起来

Expressions and Technical Terms

1. chemical bonding 化学键
2. covalent bonding 共价键
3. metallic bonding 金属键
4. ionic bonding 离子键
5. van der Waals bonding 范德华键
6. be composed of 由……组成的
7. give up 放弃
8. Sodium chlorine 氯化钠
9. be identical to 与……相似的
10. at least 至少
11. belong to 属于
12. at most 最多,至多
13. the valence electrons 原子价电子
14. electron cloud 电子云
15. ion core 离子芯,离子实
16. inert gas 惰性气体

Notes

1. It is the electronegativities of atoms that determine what bond type forms. If the atoms have high electronegativity, they share electrons in a **covalent bonding** between individual pairs of atoms. If the atoms have low electronegativity, they share electrons amongst all of the atoms in a **metallic bonding**. If some of the atoms have high and some low electronegativity, the electrons are transferred from one atom to another resulting in an **ionic bonding**. 原子的电负性决定了键的类型。如果原子(们)有高的电负性,原子间以共价键的形式共用电子;如果原子(们)有低的电负性,在所有原子中以金属键的形式来共用电子;如果原子中一些原子是高电负性的,而另外一些为低电负性的,则电子将从一个原子转移到另一个原子中形成金属键。transfer from…to… 从……到……转移。
2. The different bond types are characterized by how electrons are shared, which controls the geometry of the atom packing, and by the relative strength of the bond 不同的键可以用控制原子堆积的几何形状的电子共用形式和键的强度来表示其特征。which controls the geometry of the atom packing 是定语从句修饰前面的 how electrons are shared。
3. Atoms of a metallic element easily give up their valence electrons to the nonmetallic atoms.