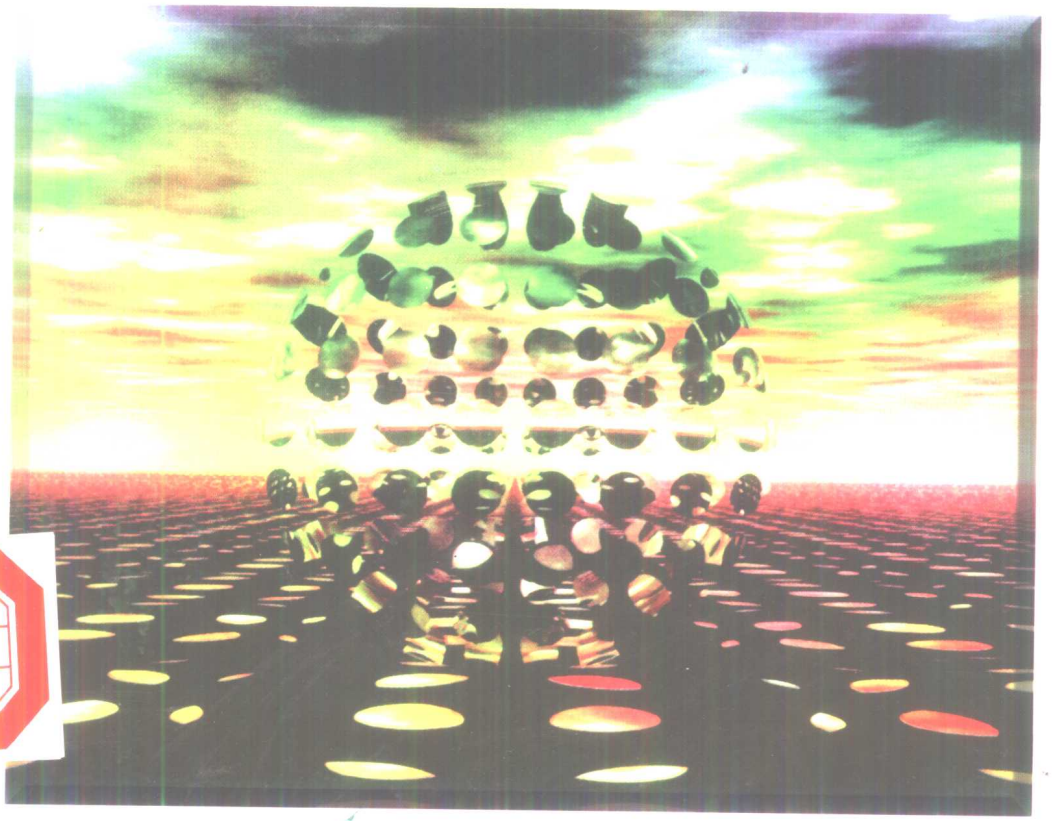
CHEMISTRY ENGLISH

化学专业英语

（修订版）

马永祥　吴隆民　梁永民
武小莉　谢继善　编



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内 容 简 介

本教材内容选自近年来国外英文原版的高等院校化学和化工类专业教学用书、各类专著以及国际纯化学和应用化学联合会的有机化合物命名法。本书自 1987 年起已先后印过两次，这次对原版本又进行了较大的修改、补充和完善。

本书选材面广，题材新颖、内容丰富，词汇量大，文体各异，句型全面，适于作高等院校的化学、化工和药物化学及相关专业的专业英语教学用书，也可作为从事化学和化工领域的教学、科研和工程技术人员的自学用书。通过对本书的学习基本可掌握化学专业英语的语音和一些构词规律，可熟记约 3000 个专业英语词汇和理解一些语法概念，从而为阅读英语资料、撰写专业英语稿件和进行国际学术交流奠定坚实的基础。

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前　言

在科技英语词汇中，涉及化学和化工领域的词汇数量最大，从事这一专业工作的技术人员在掌握专业英语时，面对的词汇量数以万计，因而使该领域人员在学习专业英语时遇到的困难最大、周期最长，为使化学、化工专业学生缩短掌握专业英语的周期和在学习中少走弯路，收到事半功倍的效果，我们于1983年选编了此教材，并经过数年使用后，于1987年由兰州大学出版社正式出版发行，发行后陆续被国内许多高等院校化学及其相关专业选作高年级教学用书，一些从事化学工作的中青年教师、出国人员、科研和工程技术人员也作为自学教材进行了学习，一般均反映该书对掌握专业英语颇有裨益。该版对前一版又进行了较大的增补和修改，因而使本书内容更加充实和完善。

本书共40课，内容涉及无机化学(元素及周期表、命名、配合物、酸碱概念等)，有机化学(命名、有机合成、金属有机、聚合物等)，物理化学(热力学、动力学、结构化学等)，化工基础(结晶、蒸馏、物料衡算)，化学文献等，并附有化学实验室常用仪器和杂环化合物的命名两篇附录，最后附有常用词组、词头和词尾的索引，以及总词汇表。

本书内容丰富，取材新颖，领域广泛，文体各异，句型繁多，词汇量大，并且均有注音和一些构词规律，对一些语法现象也进行了解释和概括。熟读本书不仅可以熟练地阅读本专业英语资料，且能用英语撰写稿件和进行国际学术交流。

本书在修改过程中，许多同志提出了宝贵建议，并得到他们的支持和帮助，特此表示谢意。

由于我们英语水平的限制，虽经多次修改和补充，仍难免有不足之处和错误，盼望读者提出宝贵意见。

编者

1996年7月于兰州

TABLE OF CONTENTS

1.

THE ELEMENTS AND THE PERIODIC TABLE

The number of protons in the nucleus of an atom is referred to as the atomic number, or proton number, Z. The number of electrons in an electrically neutral atom is also equal to the atomic number, Z. The total mass of an atom is determined very nearly by the total number of protons and neutrons in its nucleus. This total is called the mass number, A. The number of neutrons in an atom, the neutron number, is given by the quantity A-Z.

The term element refers to a pure substance with atoms all of a single kind. To the chemist the "kind" of atom is specified by its atomic number, since this is the property that determines its chemical behavior. At present all the atoms from $Z = 1$ to $Z = 107$ are known; there are 107 chemical elements. Each chemical element has been given a name and a distinctive symbol. For most elements the symbol is simply the abbreviated form of the English name consisting of one or two letters, for example:

oxygen=O nitrogen=N neon=Ne magnesium=Mg

Some elements, which have been known for a long time, have symbols based on their Latin names, for example:

iron=Fe(ferrum) copper=Cu(cuprum) lead=Pb(plumbum)

A complete listing of the elements may be found in Table 1.

Beginning in the late seventeenth century with the work of Robert Boyle, who proposed the presently accepted concept of an element, numerous investigations produced a considerable knowledge of the properties of elements and their compounds[1]. In 1869, D. Mendeleev and L. Meyer, working independently, proposed the periodic law. In modern form, the law states that the properties of the elements are periodic functions of their atomic numbers. In other words, when the elements are listed in order of increasing atomic number, elements having closely similar properties will fall at definite intervals along the list. Thus it is possible to arrange the list of elements in tabular form with elements having similar properties placed in vertical columns[2]. Such an arrangement is called a periodic table.

Each horizontal row of elements constitutes a period. It should be noted that the lengths of the periods vary. There is a very short period containing only 2 elements, followed by two short periods of 8 elements each, and then two long periods of 18 elements each[3]. The next period includes 32 elements, and the last period is apparently incomplete. With this arrangement, elements in the same vertical column have similar characteristics. These columns constitute the chemical families or groups. The groups headed by the mem-

bers of the two 8-element periods are designated as main group elements, and the members of the other groups are called transition or inner transition elements.

In the periodic table, a heavy stepped line divides the elements into metals and nonmetals. Elements to the left of this line (with the exception of hydrogen) are metals, while those to the right are nonmetals. This division is for convenience only; elements bordering the line--the metalloids-have properties characteristic of both metals and nonmetals. It may be seen that most of the elements, including all the transition and inner transition elements, are metals.

Except for hydrogen, a gas, the elements of group ⅠA make up the alkali metal family. They are very reactive metals, and they are never found in the elemental state in nature. However, their compounds are widespread. All the members of the alkali metal family form ions having a charge of 1+ only. In contrast, the elements of group IB—copper, silver, and gold—are comparatively inert. They are similar to the alkali metals in that they exist as 1+ ions in many of their compounds. However, as is characteristic of most transition elements, they form ions having other charges as well[4].

The elements of group ⅡA are known as the alkaline earth metals. Their characteristic ionic charge is 2+. These metals, particularly the last two members of the group, are almost as reactive as the alkali metals. The group ⅡB elements—zinc, cadmium, and mercury are less reactive than are those of group ⅡA[5], but are more reactive than the neighboring elements of group IB. The characteristic charge on their ions is also 2+.

With the exception of boron, group ⅢA elements are also fairly reactive metals. Aluminum appears to be inert toward reaction with air, but this behavior stems from the fact that the metal forms a thin, invisible film of aluminum oxide on the surface, which protects the bulk of the metal from further oxidation. The metals of group ⅢA form ions of 3+ charge. Group ⅢB consists of the metals scandium, yttrium, lanthanum, and actinium.

Group ⅣA consists of a nonmetal, carbon, two metalloids, silicon and germanium, and two metals, tin and lead. Each of these elements forms some compounds with formulas which indicate that four other atoms are present per group ⅣA atom, as, for example, carbon tetrachloride, CCl_4. The group ⅣB metals—titanium, zirconium, and hafnium—also form compounds in which each group ⅣB atom is combined with four other atoms; these compounds are nonelectrolytes when pure.

The elements of group ⅤA include three nonmetals—nitrogen, phosphorus, and arsenic—and two metals—antimony and bismuth. Although compounds with the formulas N_2O_5, PCl_5, and $AsCl_5$ exist, none of them is ionic. These elements do form compounds—nitrides, phosphides, and arsenides—in which ions having charges of minus three occur. The elements of group ⅤB are all metals. These elements form such a variety of different compounds that their characteristics are not easily generalized.

With the exception of polonium, the elements of group ⅥA are typical nonmetals. They are sometimes known as the chalcogens, from the Greek word meaning "ash formers". In

their binary compounds with metals they exist as ions having a charge of 2-. The elements of group ⅦA are all nonmetals and are known as the halogens, from the Greek term meaning "salt formers." They are the most reactive nonmetals and are capable of reacting with practically all the metals and with most nonmetals, including each other.

The elements of groups ⅥB, ⅦB, and Ⅷ are all metals. They form such a wide variety of compounds that it is not practical at this point to present any examples as being typical of the behavior of the respective groups[6].

The periodicity of chemical behavior is illustrated by the fact that, excluding the first period, each period begins with a very reactive metal. Successive elements along the period show decreasing metallic character, eventually becoming nonmetals, and finally, in group ⅦA, a very reactive nonmetal is found. Each period ends with a member of the noble gas family.

词　汇

element['eliment] n.　元素
proton['proutɔn] n.　质子
nucleus['nju:kləs]复 nuclei['nju:kliai] n.　核
atomic[ə'tɔmik] a.　原子的
atomic number　原子序数
neutral['nju:trəl] a.　中性的
mass[mæs] n.　质量
mass number　质量数
atom['ætəm] n.　原子
neutron['nju:trɔn] n.　中子
single kind　同一类
chemical ['kemikəl] a. 化学的　n. 化学品
symbol['simbəl] n. 符号
accept[ək'sept] vt. 接受，承认
concept[kɔnsept] n. 概念
compound[kəm'paund] n. 化合物
property['prɔpəti] n. 性质，特性
periodic[piəri'ɔdik] a. 周期的
periodic table　周期表
periodic law　周期律
state[steit] vt. 说明，认为
function['fʌŋkʃən] n. 官能；函数
tabular['tæbjulə] a. 表的
vertical['və:tikəl] a. 竖的，垂直的
column['kɔləm] n. 柱，塔；纵列
horizontal[hɔri'zɔntl] a. 水平的；横式的
row[rou] n. 排，横列
period['piəriəd] n. 周期
family['fæmili] n. (周期表的)族
group[gru:p] n. 族，基，团；　vt. 把……分成组
transition[træn'ziʃən] n. 过渡，转变
metaloid['metəlɔid] n. 准金属
characteristic[kæriktə'ristik] n. a.　特性，特点
alkali['ælkəlai] n. 碱
alkali metal　碱金属
reactive[ri'æktiv] a. 活泼的，反应的
inert[i'nə:t] a. 惰性的，不活泼的
coinage['kɔinidʒ] n. 造币，货币
ionic[ai'ɔnik] a. 离子的
alkaline['ælkəlain] a. 碱的
alkaline earth metal　碱土金属
thin[θin] a. 薄的，稀薄的 n. 薄层
invisible[in'vizəbl] a. 肉眼看不见的

film[film] n. 膜，胶片
aluminum oxide 氧化铝
surface['sə:fis] n. a. 表面
formula['fɔ:mjulə] n. 分子式，公式
oxidation[ɔksi'deiʃən] n. 氧化
carbon tetrachloride 四氯化碳
combine[kəm'bain] v. 化合，结合(with)
non-electrolyte['nɔn-i'lektrəlait] n. 非电解质
nitride['naitraid] n. 氮化物
phosphide['fɔsfaid] n. 磷化物
arsenide['ɑ:sinaid] n. 砷化物
chalcogen['kælkədʒən] n. 硫属，硫族
ash former[æʃ'fɔ:mə]灰源体，成灰(者)
binary ['bainəri] a. n. 二元(的)，双(的)
halogen['hælədʒən] n. 卤素
salt former[sɔ:lt'fɔ:mə]盐源体，成盐(者)
periodicity[piəriə'disiti] n. 周期性

前 缀

in-[in-](il-，im-，ir-)不，无，非；
incomplete，inorganic，invisible impure，irregular
non-[nɔn-]非，不，无；nonmetal，nonelectrolyte，noninflammable(不燃的)，nontoxic(无毒的)
di-[dai-]二，双，联，重，偶；dipositive，dioxide；dimolecular，diatomic；diphenyl(联苯)，dibenzoyl(联苯甲酰)；dichromate(重铬酸盐)；dipole(偶极)。

后 缀

-on[-ɔn，-ən](名词词尾)；
1. 组成原子微粒
proton，neutron，ion，electron
2. 非金属元素词尾
argon，boron，carbon，silicon
-ic [-ik](形容词词尾)；ionic，periodic，atomic，acatalytic，
-ide [-aid]…化物(名词词尾)；oxide，chloride，hydride，halide，nitride

词 组

referred to as… 称为……，被认为是……
equal to… 等于，与……相等
refer to… 涉及，指的是
(be)abbreviated from…是……的缩写，是……之略
consist of… 由……组成
(be) based (up)on… 根据……，以……为准
begin with… 从……开始
in modern form 按近代方式
a function of 随……而变，…的函数
in other words 换句话说
in order of… 按……(排列)
followed by… 接着，继之有，后面是
main group element 主族元素
for convenience 为方便起见
divide A into B and C 把A分成B和C
with the exception of… 除……之外
except for… 除……之外
make up… 形成，组成
in contrast 相反，与此对比
similar to… 类似于
exist as… 以[……形式]存在
…as well [同样]也
known as 就是通常说的……，以……著称
protect A from B 保护A不受B…[影响]；使A免于B
composed of… 由……组成
to some extent 在某种程度上
a variety of… 各种各样的
capable of (+ing)能够……，有……可能

Table 1 IUPAC* Names and Symbols of the Elements

Name		Symbol	At. No.	汉语名
Actinium	[æk'tiniəm]	Ac	89	锕
Aluminum	[ə'lju:minəm]	Al	13	铝
Americium	[æmə'risiəm]	Am	95	镅
Antimony	['æntiməni]	Sb	51	锑
Argon	['ɑ:gɔn]	Ar	18	氩
Arsenic	['ɑ:snik]	As	33	砷
Astatine	['æstətin]	At	85	砹
Barium	['bɛəriəm]	Ba	56	钡
Berkelium	['bə:kliəm]	Bk	97	锫
Beryllium	[be'riljəm]	Be	4	铍
Bismuth	['bizməθ]	Bi	83	铋
Boron	['bɔ:rɔn]	B	5	硼
Bromine	['broumi:n]	Br	35	溴
Cadmiun	['kædmiəm]	Cd	48	镉
Calcium	['kælsiəm]	Ca	20	钙
Californium	['kæli'fɔ:niəm]	Cf	98	锎
Carbon	['kɑ:bən]	C	6	碳
Cerium	['siəriəm]	Ce	58	铈
Cesium	['si:ziəm]	Cs	55	铯
Chlorine	['klɔ:rin]	Cl	17	氯
Chromium	['kroumiəm]	Cr	24	铬
Cobalt	[kə'bɔ:lt]	Co	27	钴
Copper	['kɔpə]	Cu	29	铜
Curium	['kjuəriəm]	Cm	96	锔
Dysprosium	[dis'prousiəm]	Dy	66	镝
Einsteinium	[ain'stainiəm]	Es	99	锿
Erbium	['ə:biəm]	Er	68	铒
Europium	[juə'roupiəm]	Eu	63	铕
Fermium	['fɛəmiəm]	Fm	100	镄
Fluorine	['flu(:)ərin]	F	9	氟
Francium	['frænsiəm]	Fr	87	钫
Gadolinium	[ˌgædə'liniəm]	Gd	64	钆
Gallium	['gæliəm]	Ga	31	镓
Germanium	[dʒə:'meiniəm]	Ge	32	锗
Gold	['gould]	Au	79	金
Hafnium	['hæfniəm]	Hf	72	铪
Helium	['hi:ljəm]	He	2	氦
Holmium	['hɔlmiəm]	Ho	67	钬
Hydrogen	['haidrədʒən]	H	1	氢
Indium	['indiəm]	In	49	铟
Iodine	['aiədi:n]	I	53	碘
Iridium	[ai'ridiəm]	Ir	77	铱

Iron	['aiən]	Fe	26	铁
Krypton	['kriptɔn]	Kr	36	氪
Lanthanum	['lænθənəm]	La	57	镧
Lawrencium	[lɔ:'rensiəm]	Lr	103	铹
Lead	[led]	Pb	82	铅
Lithium	['liθiəm]	Li	3	锂
Lutetium	[lju:'ti:ʃiəm]	Lu	71	镥
Magnesium	[mæg'ni:ziəm]	Mg	12	镁
Manganese	['mæŋgə ni:z]	Mn	25	锰
Mendelevium	[ˌmendə'liviəm]	Md	101	钔
Mercury	['mə:kjuri]	Hg	80	汞
Molybdenum	[mɔ'libdi:nəm]	Mo	42	钼
Neodymium	[ˌni(:)ə'dimiəm]	Nd	60	钕
Neon	[ˌni:ən]	Ne	10	氖
Neptunium	[nep'tjuniəm]	Np	93	镎
Nickel	['nikəl]	Ni	28	镍
Niobium	[nai'oubiəm]	Nb	41	铌
Nitrogen	['naitridʒən]	N	7	氮
Nobelium	[nou'beliəm]	No	102	锘
Osmium	['ɔzmiəm]	Os	76	锇
Oxygen	['ɔksidʒən]	O	8	氧
Palladium	[pə'leidiəm]	Pb	46	钯
Phosphorus	['fɔsfərəs]	P	15	磷
Platinum	['plætinəm]	Pt	78	铂
Plutonium	[plu:'tounjəm]	Pu	94	钚
Polonium	[pə'louniəm]	Po	84	钋
Potassium	[pə'tæsjəm]	K	19	钾
Praseodymium	[ˌpreiziou'dimiəm]	Pr	59	镨
Promethium	[prə'mi:θiəm]	Pm	61	钷
Protactinium	[ˌproutæk'tiniəm]	Pa	91	镤
Radium	['reidiəm]	Ra	88	镭
Radon	['reidɔn]	Rn	86	氡
Rhenium	['ri:niəm]	Re	75	铼
Rhodium	['roudiəm]	Rh	45	铑
Rubidium	[ru:'bidiəm]	Rb	37	铷
Ruthenium	[ru:'θiniəm]	Ru	44	钌
Samarium	[sə'mɛəriəm]	Sm	62	钐
Scandium	['skændiəm]	Sc	21	钪
Selenium	[si'li:njəm]	Se	34	硒
Silicon	['silikən]	Si	14	硅
Silver	['silvə]	Ag	47	银
Sodium	['soudjəm]	Na	11	钠
Strontium	['strɔnʃiəm]	Sr	38	锶
Sulfur	['sʌlfə]	S	16	硫
Tantalum	['tæntələm]	Ta	73	钽

Technetium	[tek'ni:ʃiəm]	Tc	43	锝
Tellurium	[te'ljuəriəm]	Te	52	碲
Terbium	['tə:biəm]	Tb	65	铽
Thallium	['θæliəm]	Tl	81	铊
Thorium	['θɔ:riəm]	Th	90	钍
Thulium	['θju:liəm]	Tm	69	铥
Tin	['tin]	Sn	50	锡
Titanium	[ti'teiniəm]	Ti	22	钛
Tungsten	['tʌŋsten]	W	74	钨
Uranium	[juə'reinjəm]	U	92	铀
Vanadium	[və'neidiəm]	V	23	钒
Xenon	['zenɔn]	Xe	54	氙
Ytterbium	[i'tə:bjəm]	Yb	70	镱
Yttrium	['itriəm]	Y	39	钇
Zinc	['ziŋk]	Zn	30	锌
Zirconium	[zə:'kouniəm]	Zr	40	锆

* IUPAC 是 International Union of Pure and Applied Chemistry，即："国际纯粹化学和应用化学联合会"的缩写。

课 文 注 释

1. beginning in the late seventeenth century with the work of Robert Boyle, who proposed the presently accepted concept of an element, numerous investigations produced a considerable knowledge of the properties of elements and their compounds. 其中"numerous investigations … compounds."为主句，Beginning 引导的分词短语是表示时间的状语，"who … an element"是修饰 Robert Boyle 的定语从句。本语译文："早在 17 世纪末期，罗伯特·波义耳就开始了这项工作，他提出了现在公认的元素概念，大量的研究使我们对元素及其化合物的性质有了相当的了解。"
2. Thus it is possible to arrange the list of elements in tabular form with elements having similar properties placed in vertical columns. 该句中 it 是形式主语，代替"to arrange … columns."不定式短语，此短语中 with elements … columns 是独立主格结构作方式状语，修饰 arrange。译文："于是，将具有类似性质的元素排成纵列，从而把元素排成表格形式是可能的。"
3. each：在此处作副词，一般在句子末尾，意思是"每个"，"各(个地)"，也用作形容词和代词，如"each horizontal row"和"each of these elements"。
4. However, as is characteristic of most transition elements, they form ions having other charges as well. 这里"they form … as well"是主句，"as is … elements"是关系代词 as 引导的定语从句，修饰整个句子，as 本身在从句中作主语。本句译文："然而，象许多过渡元素所具有的特点一样，它们也形成具有其它电荷的离子。"
5. than are those of group IIA: Than 后的从句，有时主、谓语颠倒。
6. They form such a wide variety of compounds that it is not practical at this point to pre-

sent any examples as being typical of the behavior of the respective groups. "They form … compounds"是主句,"that it is … 句末"是 that 引起的结果状语从句,从句中 as+现在分词短语"being … groups"是 examples 的定语。译文:"它们形成了各种不同的化合物,在这一点上我们甚至不能举出任何能表现各族元素典型变化的例子。"

2.

THE NONMETAL ELEMENTS

We noted earlier that nonmetals exhibit properties that are greatly different from those of the metals. As a rule, the nonmetals are poor conductors of electricity (graphitic carbon is an exception) and heat; they are brittle, are often intensely colored, and show an unusually wide range of melting and boiling points. Their molecular structures, usually involving ordinary covalent bonds, vary from the simple diatomic molecules of H_2, Cl_2, I_2, and N_2 to the giant molecules of diamond, silicon and boron.

The nonmetals that are gases at room temperature are the low-molecular weight diatomic molecules and the noble gases that exert very small intermolecular forces. As the molecular weight increases, we encounter a liquid (Br_2) and a solid (I_2) whose vapor pressures also indicate small intermolecular forces. Certain properties of a few nonmetals are listed in Table 2.

Table 2. Molecular Weights and Melting Points of Certain Nonmetals

Diatomic Molecules	Molecular Weight	Melting Point ℃	Color
H_2	2	−259.1[1]	None
N_2	28	−210	None
F_2	38	−223	Pale yellow
O_2	32	−218	Pale blue
Cl_2	71	−102	Yellow−green
Br_2	160	−7.3	Red−brown
I_2	254	113	Gray−black

Simple diatomic molecules are not formed by the heavier members of Groups Ⅴ and Ⅵ at ordinary conditions. This is in direct contrast to the first members of these groups, N_2 and O_2. The difference arises because of the lower stability of π bonds formed from p orbitals of the third and higher main energy levels as opposed to the second main energy lev-

el[2]. The larger atomic radii and more dense electron clouds of elements of the third period and higher do not allow good parallel overlap of p orbitals necessary for a strong π bond. This is a general phenomenon—strong π bonds are formed only between elements of the second period. Thus, elemental nitrogen and oxygen form stable molecules with both σ and π bonds, but other members of their groups form more stable structures based on σ bonds only at ordinary conditions. Note[3] that Group Ⅶ elements form diatomic molecules, but π bonds are not required for saturation of valence.

Sulfur exhibits allotropic forms. Solid sulfur exists in two crystalline forms and in an amorphous form. Rhombic sulfur is obtained by crystallization from a suitable solution, such as CS_2, and it melts at 112 C. Monoclinic sulfur is formed by cooling melted sulfur and it melts at 119 C. Both forms of crystalline sulfur melt into S-gamma, which is composed of S_8 molecules. The S_8 molecules are puckered rings and survive heating to about 160 C. Above 160 C, the S_8 rings break open, and some of these fragments combine with each other to form a highly viscous mixture of irregularly shaped coils. At a range of higher temperatures the liquid sulfur becomes so viscous that it will not pour from its container. The color also changes from straw yellow at sulfur's melting point to a deep reddish-brown as it becomes more viscous.

As[4] the boiling point of 444 C is approached, the large-coiled molecules of sulfur are partially degraded and the liquid sulfur decreases in viscosity. If the hot liquid sulfur is quenched by pouring it into cold water, the amorphous form of sulfur is produced. The structure of amorphous sulfur consists of large-coiled helices with eight sulfur atoms to each turn of the helix; the overall nature of amorphous sulfur is described as[5] rubbery because it stretches much like ordinary rubber. In a few hours the amorphous sulfur reverts to small rhombic crystals and its rubbery property disappears.

Sulfur, an important raw material in industrial chemistry, occurs as[5] the free element, as[5] SO_2 in volcanic regions, as H_2S in mineral waters, and in a variety of sulfide ores such as iron pyrite FeS_2, zinc blende ZnS, galena PbS and such, and in common formations of gypsum $CaSO_4 \cdot 2H_2O$, anhydrite $CaSO_4$, and barytes $BaSO_4$. Sulfur, in one form or another, is used in large quantities for making sulfuric acid, fertilizers, insecticides, and paper.

Sulfur in the form of SO_2 obtained in the roasting of sulfide ores is recovered and converted to sulfuric acid, although in previous years much of this SO_2 was discarded through exceptionally tall smokestacks. Fortunately, it is now economically favorable to recover these gases, thus greatly reducing this type of atmospheric pollution. A typical roasting reaction involves the change:

$$2\ ZnS + 3\ O_2 \rightarrow 2\ ZnO + 2\ SO_2$$

Phosphorus, below 800 C, consists of tetratomic molecules, P_4. Its molecular structure provides for a covalence of three, as may be expected from the three unpaired p electrons in its atomic structure, and each atom is attached to three others[6]. Instead of a strictly orthogonal orientation, with the three bonds 90° to each other, the bond angles are only 60°. This

supposedly strained structure is stabilized by the mutual interaction of the four atoms (each atom is bonded to the other three), but it is chemically the most active form of phosphorus. This form of phosphorus, the white modification, is spontaneously combustible in air. When heated to 260℃ it changes to red phosphorus, whose structure is obscure. Red phosphorus is stable in air but, like all forms of phosphorus, it should be handled carefully because of its tendency to migrate to the bones when ingested, resulting in serious physiological damage.

Elemental carbon exists in one of two crystalline structures—diamond and graphite. The diamond structure, based on tetrahedral bonding of hybridized sp^3 orbitals, is encountered among Group Ⅳ elements. We may expect that as the bond length increases, the hardness of the diamond-type crystal decreases. Although the tetrahedral structure persists among the elements in this group—carbon, silicon, germanium, and gray tin—the interatomic distances increase from 1.54 Å for carbon to 2.80 Å for gray tin. Consequently, the bond strengths among the four elements range from very strong to quite weak. In fact, gray tin is so soft that it exists in the form of microcrystals or merely as a powder. Typical of the Group Ⅳ diamond-type crystalline elements, it is a nonconductor and shows other nonmetallic properties[7].

词　汇

exhibit[ig'zibit] vt. n. 显示，表示，呈现
graphitic[græ'fitik] a. 石墨的
graphite['græfait] n. 石墨
brittle['britl] a. 易碎的
intensely[in'tensli] ad. 强烈地
diatomic molecule 双原子分子
melting point['meltiŋ' pɔint] 熔点
boiling point['bɔiliŋ' pɔint] 沸点
molecule['mɔlikju:l] n. 分子，克分子
molecular[mou'lekjulə] a. 分子的
molecular weight 分子量
structure['strʌktʃə] n. 结构
valent['veilənt] a. 价的
covalent[kou'veilənt] a. 共价的
valence['veiləns] n. (原子)价
bond[bɔnd] n. 键；vi. 结合，相接
diamond['daiəmənd] n. 金刚石
exert[ig'zə:t] vt. 产生，采用
liquid['likwid] n. a. 液体
solid['sɔlid] n. a. 固体
vapor['veipə] n. 蒸汽
pressure['preʃə] n. 压力
intermolecular[ˌintə(:)mou'lekjulə] a. 分子间的
arise[ə'raiz] vi. 出现，发生
stability[stə'biliti] n. 稳定性，安定性
stable['steibl] a. 稳定的，安定的
orbital['ɔ:bitl] n. a. 轨道
energy level['enədʒi' levl]能级
radius['reidiəs](复 radii['reidiai])n. 半径
electron[i'lektrɔn] n. 电子
electron cloud 电子云
parallel['pærəlel] a. 平行的，同一方向的
overlap[ouvə'læp] n. v. 重叠
phenomenon[fi'nɔminən] n. 现象
allotropic[ælə'trɔpik] a. 同素异形的
crystalline['kristəlain] a. n. 结晶
crystal['kristl] n. 结晶