

内 容 简 介

本书由作者在南开大学为化学系本科生讲授“双语化学入门”课程所用讲义加工改编而成。书中介绍了外国语言的快速有效的学习方法,引导学生自学成才。本书包括 12 章,内容涉及化学元素、无机化合物命名法、简单有机化合物命名法、化学中的度量、有效数字、气体分子运动论、金属的晶体结构、周期律与电子结构、元素的电子结构、离子键、电子对互斥与分子几何结构、化学热力学。书中还提供了化学英语常用资料和英汉对照词汇供读者学习使用。

本书适合作为高等院校化学英语的入门教材,也可供自学者参考。

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为了适应我国加入世界贸易组织后高等学校教育改革的需要和落实教育部关于提高教学质量文件的要求,实行双语教学的问题已经提上教学议事日程。在双语教学工作中,首要的问题是应该先解决相应适用的教材。这里存在着若干困难。一方面,我们需要有我们自己的既能引入国际前沿的科技知识、又能反映我国发展实际水平的母语特色教材。另一方面,双语教学也需要有可用的课件。如果引入国外原版教科书,无论是购买原版书,或是购买版权影印,都将会是所费不赀的。比较方便的解决办法,是组织有能力的教师编写外文教材,利用我们自己的教材成本相对较低,不给师生增加过高的经济负担。

笔者在 20 世纪 80 年代,曾经有过讲授专业英语的经验,积累了一套快速高效入门双语化学的经验,称为“以朗读为中心的外语速效学习法”。2003 年秋季开学,利用双休日,给 240 名大学一年级本科生开设了一门 1 个学分(18 学时)的“双语化学入门”课,教给学生自学方法,引导他们“自学成才”掌握化学双语知识,收到了轰动性的效果。下面介绍学习方法和教学经验,供与兄弟学校交流。

以朗读为中心的外语速效学习法 学习一门外语的有效方法,就是中国古人学习古文章的三步走办法:朗读——熟记——背诵。小孩子咿呀学语,就是天天跟大人学说话,天天记,时时反馈。小孩子学说话也没有先抠语法的,语法是自然而然形成的语言习惯,没有什么理论规律性。就这一点浅显道理,在已有高中外语学习的基础上,强化一种语言的学习,最有效的方法,就是养成快速朗读外语文章的习惯,持之以恒,百炼成钢。

以朗读为中心的外语学习方法,是一种全面的方法训练,可达到以下的多方面效果:

(1) 训练读文字的目力 经常锻炼快速朗读,日久可以达到,口里读着一行文字,眼睛已经望到下一行去了,这样才能快读下去。训练快速目力,非常有用。

(2) 训练口语 中国人的语言是慢速度的,而外国语言是快速度的,在语音速度上有一个差距,快速朗读养 习惯,可以弥补这个差距。在朗读中注意读音正确,形成好习惯。

(3) 训练耳朵听力 如上所述,中国语言是慢速的,养成我们的耳朵听力也是慢速的,不能适应与外国人对话。养成快速朗读文件的习惯,练习越读越快,给自己听,就训练了自己的耳朵听力,由慢速进入快速。这是惟一的最有效的自我锻炼。

(4) 训练外语思维 在快速朗读当中,大脑中有一部分主管看和读出声,另一部分主管听和输入脑干理解。这两部分达到共鸣,就得到了全面训练:也看了,也读了,也听了,也理解了。更重要的是,养 练快速朗读习惯,在大脑储存器中输入和存储越来越多的文字信息,就会熟能生巧,发生质变,产生人工智能。原来外文信息输入,先通过大脑翻译功能翻译成汉语,再加以理解识别,这样构成一个慢速行为。需要反馈时,又是先有汉语思维,再由大脑翻译成外文,再通过语言反馈出去,又慢了一步。所以中国人跟外国人初次对话,往往磕磕巴巴,语言流利不起来。快速朗读经验多了,大脑发生了变化,把汉语思维自动地转变为外语思维,外语思维输入,外语思维反馈。看、读、听、理解、输入,反馈全面速度加快,不就是已经精通了外语吗!这就是外语的自学成才。

(5) 快速朗读学习外语,不需要再专抠语法 外语语法,只是语言习惯,没有什么理论章法。例如说,讲时间,要讲 *in the year, on the day, at the time*,为什么要用不同的前置词?没有什么道理可讲。学一种语言去抠语法,是一种最愚蠢的学习方法。快速朗读学习,自然而然就把语法与文字在大脑中熟练结合,随时呼之即出,不需死记硬背。这也是朗读法的优越之处。

笔者传授给学生的具体学习方法是,首先选定一篇文章,例如一篇化学课文,或是外文报章如“China Daily”上找一篇报道文章,清晨早起,在室外找一个安静处,朗读那篇文章,逐步加快速度地反复朗读,边朗读边思考理解,一直到熟练为止,争取达到每天朗读1小时,坚持不懈。在初读时,遇到新单词不会,可以不理睬它,继续读下去,领会了全篇意义,也就可以猜出来那个单词的含义了。读几遍以后,再查查随手带的字典,就可以把新单词牢牢地输入脑中记住了,不



需单独去背单词。专门单独背单词,也是愚蠢的学习办法。

坚持这种朗读学习 3 个月,自己想各种方法检查学习效果,就会发现你的外语水平大大进步了。如果坚持一个学期,坚持一年,大概你参加英语六级考试,不会有什么困难了。事在人为,全靠自己的自觉努力。正是“天下无难事,只怕有心人”,笔者祝愿进入化学学科的学者,人人都能学好英语。

本教材包括 12 章,内容涉及化学元素、无机化合物命名法、简单有机化合物命名法、化学中的度量、有效数字、气体分子运动论、金属的晶体结构、周期律与电子结构、元素的电子结构、离子键、电子对互斥与分子几何结构、化学热力学。在附录中提供了化学英语中的一些常识性资料,并特别编写了基础的化学英语词汇,适合为大学一年级化学概论课的化学英语查索之用。相信这本小书能够为学生的双语化学启蒙学习提供较大的便利。

申泮文
2004 年 2 月于南开大学

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Chapter 1

The Chemical Elements and Their Relative Atomic Masses

关键词

chemical element 化学元素
relative atomic mass 相对原子质量
atomic weight 原子量
invariant 不变量
radioactive element 放射性元素
isotope 同位素
half-life 半衰期
uncertainty 未确定值
source 来源

IUPAC 国际纯粹与应用化学委员会缩写词
Commission on Atomic Weights and Isotopic Abundances 原子量与同位素丰度委员会
under review 在评议中
Pure and Applied Chemistry 《纯粹与应用化学》期刊

The masses of many elements are not invariant but depend on the origin and treatment of the material. The values given on the table apply to elements as they exist naturally on earth. Values in brackets are used for radioactive elements whose atomic masses cannot be quoted precisely without knowledge of the origin of the elements; the value given is the relative atomic masses of the isotope of the element having the longest half-life. A number in parentheses indicates the uncertainty in the last digit of the atomic weight.

International Union of Pure and Applied Chemistry (IUPAC) Commission on Atomic Weights and Isotopic Abundances. The names and symbols for elements are under review. The temporary system recommended by J. Chatt (see *Pure and Applied Chemistry*,) is used in the table. The names of elements were agreed in (See *Pure and Applied Chemistry*)



摇摇

(Continued)

元素名称	符号	类别	相对原子质量
氦 Helium	He	圆	4.002602(5)
铥 Holmium	Ho	远苑	164.93032(2)
氢 Hydrogen	H	员	1.00784(7)
铟 Indium	In	源恩	114.818(8)
碘 Iodine	I	缘表	126.90447(3)
铱 Iridium	Ir	苑苑	192.222(1)
铁 Iron	Fe	园远	55.845(2)
氪 Krypton	Kr	猿远	83.801(2)
镧 Lanthanum	La	缘苑	138.90547(3)
镱 Lawrencium	Lr	员猿	[103]
铅 Lead	Pb	愿园	207.2(1)
锂 Lithium	Li	猿	6.941(3)
镥 Lutetium	Lu	苑员	174.967(1)
镁 Magnesium	Mg	员园	24.304(6)
锰 Manganese	Mn	园缘	54.938044(3)
钨 Meitnerium	Mt	员恩	[108]
钿 Mendeleevium	Md	员员	[101]
汞 Mercury	Hg	愿园	200.59(2)
钼 Molybdenum	Mo	源园	95.94(1)
钕 Neodymium	Nd	远园	144.242(1)
氖 Neon	Ne	员园	20.1797(6)
镎 Neptunium	Np	怨猿	[104]
镍 Nickel	Ni	园愿	58.71(8)
铌 Niobium	Nb	源员	92.90638(2)
氮 Nitrogen	N	苑	14.00643(4)
镎 Nobelium	No	员园	[106]
锇 Osmium	Os	苑远	193.06(1)
氧 Oxygen	O	愿	15.999(4)
钯 Palladium	Pd	源远	106.3631(8)
磷 Phosphorus	P	员缘	30.973762(5)
铂 Platinum	Pt	苑愿	195.084(8)
钚 Plutonium	Pu	怨源	[107]
钋 Polonium	Po	愿源	[109]
钾 Potassium	K	员恩	39.0983(1)
镨 Praseodymium	Pr	缘恩	140.90766(2)
钷 Promethium	Pm	远员	[105]
镤 Protactinium	Pa	怨员	231.036888(2)

(Continued)

元素名称	符号	粤读音	粤拼
镭 Radium	Ra	愿	[愿元]
氡 Radon	Rn	愿	[愿元]
铼 Rhenium	Re	殊	殊缘 [殊缘元]
铑 Rhodium	Rh	殊	殊缘 [殊缘元]
铷 Rubidium	Rb	猿	愿猿 [愿猿元]
钌 Ruthenium	Ru	源	愿源 [愿源元]
钚 Rutherfordium	Rf	愿源	[愿源元]
钐 Samarium	Sm	远	愿猿 [愿猿元]
钪 Scandium	Sc	愿	愿缘 [愿缘元]
锿 Seaborgium	Sg	愿	[愿元]
硒 Selenium	Se	猿	愿猿 [愿猿元]
硅 Silicon	Si	源	愿缘 [愿缘元]
银 Silver	Ag	源	愿源 [愿源元]
钠 Sodium	Na	员	愿猿 [愿猿元]
锶 Strontium	Sr	猿	愿猿 [愿猿元]
硫 Sulfur	S	远	愿缘 [愿缘元]
钽 Tantalum	Ta	殊	愿缘 [愿缘元]
锝 Technetium	Tc	源	[愿元]
碲 Tellurium	Te	缘	愿缘 [愿缘元]
铽 Terbium	Tb	殊	愿缘 [愿缘元]
铊 Thallium	Tl	愿	愿缘 [愿缘元]
钍 Thorium	Th	愿	愿缘 [愿缘元]
铥 Thulium	Tm	远	愿缘 [愿缘元]
锡 Tin	Sn	缘	愿缘 [愿缘元]
钛 Titanium	Ti	愿	愿缘 [愿缘元]
钨 Tungsten	W	殊	愿缘 [愿缘元]
Ununnilium	Uun	员	[愿元]
Unununium	Uuu	员	[愿元]
铀 Uranium	U	愿	愿缘 [愿缘元]
钒 Vanadium	V	缘	愿缘 [愿缘元]
氙 Xenon	Xe	缘	愿缘 [愿缘元]
镱 Ytterbium	Yb	苑	愿缘 [愿缘元]
钇 Yttrium	Y	猿	愿缘 [愿缘元]
锌 Zinc	Zn	猿	愿缘 [愿缘元]
锆 Zirconium	Zr	源	愿缘 [愿缘元]

Chapter 2

Nomenclature of Inorganic Compounds

运 用 单 词 选 择 关 键 词

acid-base reaction 酸碱反应

acid 酸

alkali metal 碱金属

alkaline earth metal 碱土金属

allotrope 同素异形体

alpha(α) particle α 粒子

alpha ray α 射线

anion 阴离子

atom 原子

atomic number 原子序数

atomic weight 原子量

base 碱

beta(β) particle β 粒子

beta ray β 射线

cation 阳离子

binary compound 二元化合物

chemical formula 化学式

diatomic molecule 双原子分子

electron 电子

empirical formula 实验式

families 族

gamma(γ) ray γ 射线

group 元素族

halogen 卤素

hydrate 水合物

ion 离子

ionic compound 离子型化合物

isotope 同位素

law of conservation of mass 质量守恒定律

law of definite proportion 定比定律

law of multiple proportion 倍比定律

mass number 质量数

metal 金属

metalloid 准金属, 非金属

molecular formula 分子式

molecule 分子

monoatomic ion 单原子离子

neutron 中子

noble gas 惰性气体

nonmetal 非金属

nucleus 原子核

oxyacid 含氧酸

oxyanion 含氧阴离子

oxide 氧化物	proton 质子
period 周期	radiation 辐射
periodic table 周期表	radioactivity 放射性
polyatomic ion 多原子离子	structural formula 结构式
polyatomic molecule 多原子分子	ternary compound 三元化合物

The composition of a compound may be specified by giving either its formula or its name. Here, we consider a problem that of developing a system of nomenclature for the chemical compounds. In the interest of clarity and simplicity, we shall restrict our discussion to a relatively small number of rules which will suffice to name the great majority of inorganic compounds encountered in an introductory course in chemistry.

2.1 Ionic Compounds

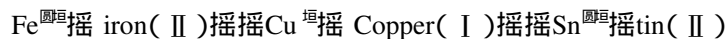
The names of ionic compounds are derived from those of the ions of which they are composed. We shall first consider the nomenclature of individual ions and then the names of the compounds they form.

2.1.1 Positive Ions

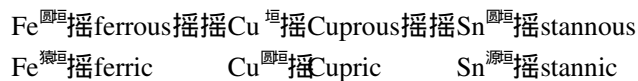
Monoatomic positive ion takes the name of the metal from which they are derived.



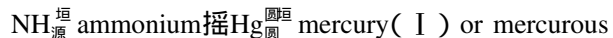
When a metal forms more than one ion, it is necessary to distinguish between these ions. The accepted practice today is to indicate the oxidation number of the ion by a Roman numeral in parentheses immediately following the name of the metal.



An earlier method, still widely used, adds to the stem of the Latin name of the metal the suffixes *-ous* or *-ic*, representing the lower and higher oxidation states respectively:



The only polyatomic cation to be considered here are :



2.1.2 摇 Negative Ions

Monoatomic negative ions named by adding the suffix *ide* to the stem of the name of the nonmetal which they are derived.

$\text{N}^{\text{猿}}$ nitride	$\text{O}^{\text{圆}}$ oxide	$\text{F}^{\text{原}}$ fluoride	$\text{H}^{\text{原}}$ hydride
	$\text{S}^{\text{圆}}$ sulfide	$\text{Cl}^{\text{原}}$ chloride	
	$\text{Se}^{\text{圆}}$ selenide	$\text{Br}^{\text{原}}$ bromide	
	$\text{Te}^{\text{圆}}$ telluride	$\text{I}^{\text{原}}$ iodide	

The nomenclature of polyatomic anions is more complex. The names of some of the more common oxyanions are :

$\text{OH}^{\text{原}}$ hydroxide	$\text{NO}^{\text{原}}$ nitrite	$\text{ClO}^{\text{原}}$ chlorite
$\text{O}^{\text{圆}}$ peroxide	$\text{SO}^{\text{圆}}$ sulfate	$\text{ClO}^{\text{原}}$ hypochlorite
$\text{CO}^{\text{圆}}$ carbonate	$\text{SO}^{\text{圆}}$ sulfite	$\text{MnO}^{\text{原}}$ permanganate
$\text{PO}^{\text{猿}}$ phosphate	$\text{ClO}^{\text{原}}$ perchlorate	$\text{CrO}^{\text{圆}}$ chromate
$\text{NO}^{\text{原}}$ nitrate	$\text{ClO}^{\text{原}}$ chlorate	$\text{Cr}_2\text{O}_7^{\text{圆}}$ dichromate

It will be noted when the nonmetal such as nitrogen or sulfur forms two oxyanions in different oxidation states the suffixes *-ate* and *-ite* are used to distinguish between the higher and lower states respectively. With elements such as chlorine which form more than two oxyanions the prefixes *-per* (the highest oxidation state) and *-hypo* (the lowest oxidation state) are used as well.

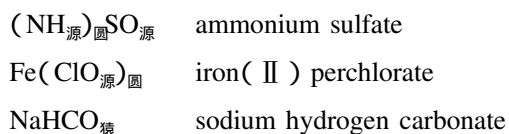
Oxyanions that contain hydrogen as well as nonmetal and oxygen atoms are properly named as illustrated in the following examples :

$\text{HCO}_3^{\text{猿}}$ hydrogen carbonate	$\text{HPO}_4^{\text{圆}}$ hydrogen phosphate
$\text{HSO}_4^{\text{原}}$ hydrogen sulfate	$\text{H}_2\text{PO}_4^{\text{原}}$ dihydrogen phosphate

2.1.3 摇 Compounds

The name of the positive ion is given first, followed by the name of the negative ion. Examples are :

CaCl_2	calcium chloride
FeBr_2	iron(II) bromide

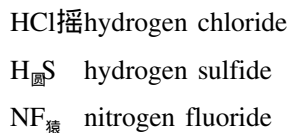


In practice ,compounds containing metal atoms ,regardless of the type of bonding involved ,are ordinarily named as if they were ionic. For example ,the compound AlCl_3 and SnCl_4 ,in both of which the bonding is primarily covalent ,are named as follows :

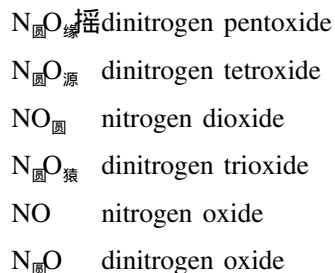


2.2 Binary Compounds of the Nonmetals

When a pair of nonmetals form only one compound ,that compound may be named quite simply. The name of the element whose symbol appears first in the formula is written first. The second portion of the name is formed by addition the suffix *-ide* to the stem of the name of the second nonmetal. Examples include



If more than one binary compound is formed by a pair of nonmetals ,as is most often the case ,the Greek prefixes *di* ,*tri* ,*tetra* ,*penta* ,*hexa* and so on ,are used to designate the number of atoms of each element. Thus ,the oxides of nitrogen are named :



A great many of the best known binary compounds of the nonmetals have acquired common names which are widely and ,in some cases ,exclusively used. These include

H_2O	water	PH_3	phosphine
H_2O_2	hydrogen peroxide	AsH_3	arsine
NH_3	ammonia	NO	nitric oxide
N_2H_4	hydrazine	N_2O	nitrous oxide

2.3 Oxyacids

The names of some of the more common oxygen acids are listed as follows :

H_2CO_3	carbonic acid	H_2SO_3	sulfurous acid
H_3BO_3	boric acid	HClO_4	perchloric acid
HNO_3	nitric acid	HClO_3	chloric acid
HNO_2	nitrous acid	HClO_2	chlorous acid
H_2SO_4	sulfuric acid	HClO	hypochlorous acid

It is of interest to compare the names of these oxyacids to those of the corresponding oxyanions listed previously. Note that oxyanions whose names end in *-ate* are derived from acid whose names end in *-ic*. Compare, for example, CO_3^{2-} (carbonate) and H_2CO_3 (carbonic acid), NO_3^- (nitrate) and HNO_3 (nitric acid), ClO_4^- (perchlorate) and HClO_4 (perchloric acid). Oxyanions whose names end in *-ite* are derived from acids whose names end in *-ous*. Thus, NO_2^- (nitrite) and HNO_2 (nitrous acid), ClO_2^- (hypochlorite) and HClO_2 (hypochlorous acid).

2.4 Coordination Compounds

The nomenclature of compounds containing complex ions in which a metal atom is held by coordinate covalent bond to two or more ligands is perhaps more involved than that of any other type of inorganic compound. Several rules are required, the more pertinent of which are as follows.

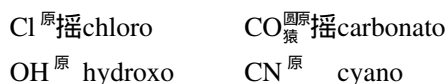
(一) As in simple ionic compounds, the cation is named first, followed by the anion.

(二) If there is more than one ligand of a particular type attached to the central atom, Greek prefixes are used to indicate the number of these ligands. Where the name of the ligand itself is complex (e. g. ethylenediamine), the number of such

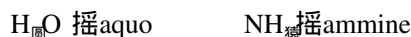
ligands is indicated by the prefixes *bis-* or *tris-* instead of *di-* or *tri-* and the name of the ligand is enclosed in parenthesis.

(猿) In naming a complex ion ,the names of ionic ligands are written first , followed by those of neutral ligands ,and finally that of the central metal. This is exactly the reverse of the order in which the groups are listed in the formula of the complex ion ,the symbol of the central atom is written first ,followed by the formula of neutral ligands and then those of negatively charged ligands. In writing the formula of coordination compound ,the formula of the complex ion is often set off by brackets.

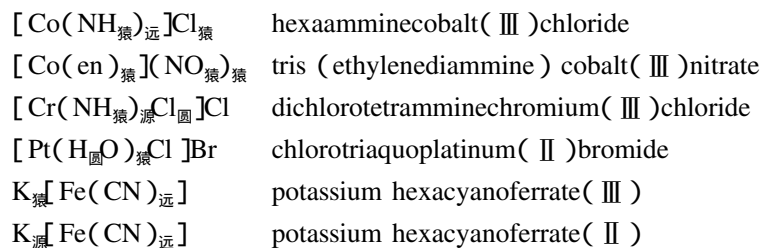
(源) The names of anionic ligands are modified by substituting the suffix *-o* for the usual ending. Thus we have



The names of neutral ligands are ordinarily not changed. Two important exceptions are :



(缘) The oxidation number of the central metal atom is indicated by a Roman numeral following the name of the metal. If the complex is an anion ,the suffix *-ate* is added ,often to the Latin stem of the name of the metal. Examples are



The last two compounds are often referred to as potassium ferricyanide and potassium ferrocyanide respectively.

Chapter 3

Nomenclature of Simple Organic Compounds

运 送 宰 燥 措 关 键 词

摇 摇 alcohol 摇 醇

aldehyde 摇 醛

aliphatic hydrocarbon 摇 脂肪烃

alkane 摇 烷烃

alkene 摇 烯烃

alkyl group 摇 烷基

alkyne 摇 炔烃

amine 摇 胺

aromatic compound 摇 芳香化合物

carboxylic acid 摇 羧酸

cycloalkane 摇 环烷烃

ester 摇 酯

ether 摇 醚

functional group 摇 官能团

isomer 摇 异构体

isomerism 摇 异构现象

ketone 摇 酮

3.1 摇 C lass ifica tion of O rganic Com pounds

摇 摇 Carbon can form more compounds than any other element because carbon atoms are able not only to form single ,double ,and triple carbon-carbon bonds ,but also to link up with each other in chains and ring structures. The branch of chemistry that deals with carbon compounds is 燥 宰 燥 措 关 键 词

Classes of organic compounds can be distinguished according to functional groups they contain. A 燥 宰 燥 措 关 键 词 is a group of atoms that is largely responsible for the chemical behavior of the parent molecule. Different molecules containing the same kind of functional group or groups undergo similar reactions.