ZZ 普通中等专业教育机电类规划教材

热加工专业英语

ENGLISH COURSE FOR HOT-WORKING OF METALS

沈阳市机电工业学校　李学哲
无锡机械制造学校　顾惠秋
主编

机械工业出版社

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本教材是根据中等专业学校“专业英语教学大纲”的要求编写的。全书分为五部分共29个单元：第一部分8个单元是金属材料基础内容；第二部分7个单元是铸造内容；第三部分6个单元是焊接内容；第四部分6个单元是热处理内容；第五部分2个单元是锻造内容。在每一部分中，分别简介了有关专业的主要内容。在每一单元中都包括课文与阅读材料，并列出生词表及对文中疑难句子的注释；同时附有思考题，以加深对文章的理解。

本书既可供中等专业学校、职业学校的热加工各单一专业及复合专业作教材使用，也可为初、中级工程技术人员学习参考之用。

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前　言

根据机械工业部部颁中等专业学校“专业英语教学大纲”的要求，在学完基础英语之后要开设专业英语课程，以使学生能够在学完本课程后，达到借助工具书顺利阅读有关英文资料的水平。本着这一精神，我们编写了这本《热加工专业英语》教材，供热加工类各单一专业及复合专业使用。

全书分五个部分，包括了金属材料基础及热加工类的四个专业的内容。每个部分包括若干个单元。每一单元中，有课文一篇，阅读材料一篇。课文后附有生词表和注释及若干个思考题；阅读材料后面对疑难之处也作了简单注释。

第一部分：金属材料基础 8 个单元，由江苏省无锡机械制造学校顾惠秋（第 1、5、7 单元），山东省机械工业学校项东（第 2、6 单元）和常州铁路机械学校徐建伟（第 3、4、8 单元）共同完成，由顾惠秋统稿。

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第五部分：锻造 2 个单元，由长治机电工业学校张敏完成。

全书的课文与阅读材料大部分选自原版文章，难度适宜，内容广泛，基本上覆盖了热加工类各专业的主要内容，保持了专业知识的系统性。

全书由李学哲、顾惠秋主编。中国科学院沈阳金属研究所陈立佳博士协助审阅，在此表示衷心的感谢。

由于时间仓促，加之编者水平有限，故错漏之处在所难免，望指正。

编者

1997 年 4 月

CONTENTS

PART ONE METALLIC MATERIALS RUDIMENTS

Unit 1. Metal and Civilization

Materials are probably more deep-seated in our culture than most of us realize[1]. Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fill their needs[2]. In fact, early civilizations have been designated by the level of their materials development, for example, stone age, bronze age, and iron age.

Solid materials have been conveniently grouped into three basic classifications: matals, ceramics, and polymers. This scheme is based primarily on chemical makeup and atomic structure, and most materials fall into one distinct grouping or another, although there are some intermediates. What may be considered to be a fourth group--the composites-consists of combinations of two or more different materials.

In the field of machine building, metal is most frequently used.

What is the metal?

In engineering, metals are understood as substances possessing a characteristic 'metallic lustre' (all metals are more or less lustrous) and plasticity. In this respect, they are easily distinguishable from non-metals, such as, wood, stone, glass or porcelain.

"Metals are bright bodies which may be forged" — this definition given by Russian scientist M. V. Lomonosov more then 200 years ago still retains its scientific meaning. The above properties are found not only in pure metals, but also in more complex substances composed of a few metallic elements and sometimes with an admixture of noticeable quantities of non-metallic elements[3]. Such substances are called metallic alloys. Therefore, metallic alloys can also be called metals in a broder sence.

The classical Greek civilization knew of seven metals: gold, silver, copper, iron, tin, lead and mercury. Gold and, to a lesser extent, silver, were called 'noble metals'. Both metals were used for coins and ornaments in almost all civilizations. To a great extent the value placed on gold and silver is due to their lack of reactivity. In this world where all other things die and pass away, gold, and sometimes also silver, remain.

Gold, silver ,and copper occur as free metals, and free iron only occurs in some meteorites. In the earth, we can find the iron ore which is an iron oxide. The iron oxide is usually a componnd of iron and oxygen. Breaking up the oxide to get metals is called smelting. Metallurgy was probably established when observant men found that certain stones around a compfire had been "changed" into a metal. Thus ancient civilizations slowly learned to extract iron from its ores by heating.

In the very early days, ancient man also learned to make fires hot enough to melt metals in earthenware containers, called "crucibles". He discovered that the molten metal could be poured into the cavity made by placing together two halves of a hollowed-out clay or stone mould: the metal filled the cavity and, when solid, it was found to have taken the shape of the cavity④.

The art of blending metals was gradually developed and it became known that an 'alloy' formed in this way was sometimes stronger, harder, and tougher than the metals of which it was composed⑤. Probably the first alloy being made was a bronze, consisting of copper, with about one part in ten of tin. The primitive metallurgists discovered that if a greater proportion of tin were used the alloy was harder, while less tin gave a softer alloy, so that for different purpose bronzes with varying tin contents were deliberately produced.

In tbe twentieth century the expansion of the use of metals has heen so rapid that considerably more metal has been extracted⑥. Our material civilization and every amenity of life depend on the work of tbe metallurgist and on his ability to produce the right metal for each particular purpose⑦. In the morning we are awakened by an alarm clock, the working components of which are metallic. We press an electric swich and current passed along a copper wire to light a lamp with a tungsten filament. we read a newspaper that has been printed witb a lead alloy type-metal. During one day, hundreds of metal objects may be used, whether we operate a lathe, supervise a computer or drive a car.

Our material civilization depends on tbe effecient harnessing of power, but the control of this power is made possible by the use of metals and alloys. Without metals no railway, aeroplane, motor car, electric motor or interplanetary space vehicle could operate.

A rigid classification of tbe elements into metals, such as iron and copper, and non-metals, such as carbon and boron, is not completely valid. Elements such as antimony have properties cbaracteristic of non-metals, with some metallic tendencies; they are known as semi-metals or metalloids. Anotber intermediate group, known as *semi-conductors*, includes silicon and germanium; they beve a low electrical conductivity characteristic of non-metals but the conductivity increases with increase of temperature; furtbermore their conductivity can be controlled by the addition of minute quantities of impurities, a phenomenon that led to the twentieth-century development of transistors.

While development of the new metals is proceeding, fresh endeavours are continually being made to widen the scope of the well-known materials⑧.

New Words and Expressions

deep-seated a.(感情,原因,疾病等)由来已久的,根深蒂固的

intimately /'intimitli/ ad.亲密,紧密

manipulate /mə'nipjuleit/ vt.熟练地使用,处理

designate /'dezigneit/ vt.指明,标示

metal /metl/ n.金属,金属合金,金属元素

ceramic /si'ræmik/ a.n.陶瓷(的),陶器(的)

polymer /'pɔlimə/ n.聚合物,聚合体,

多聚物

composite /ˈkɔmpəzit/ n. 合成物,复合材料

possess /pəˈzes/ vt. 具有,占用,拥有,支配,保持

lustre, luster /ˈlʌstə/ n. 光泽,光彩

plasticity /plæsˈtisiti/ n. 可塑性,塑性,

porcelain /ˈpɔːslin/ n. 瓷,(总称)瓷器

coin /kɔin/ n. 硬币

ornament /ˈɔːnəmənt/ n. 装饰(品)

meteorite /ˈmiːtjərait/ n. 陨石

earthenware /ˈəːθənwɛə/ n. 陶器

crucible /ˈkruːsibl/ n. 坩埚

cavity /ˈkæviti/ n. 洞,中空,空腔

blend /blend/ vt. 混合

bronze /brɔnz/ n. 青铜,青铜制品

primitive /ˈprimitiv/ a. 原始的,太古的

metallurgist /meˈtælədʒist/ n. 冶金学家

deliberately /diˈlibəritli/ ad. 深思熟虑地,慎重地

expansion /iksˈpænʃən/ n. 扩张,扩大,发展

extract /iksˈtrækt/ vt. 提取

amenity /əˈmiːniti/ n. (环境,气候的)舒服

tungsten /ˈtʌŋstən/ n. 钨

filament /ˈfiləmənt/ n. 灯丝

harness /ˈhɑːnis/ vt. 治利,利用

interplanetary /ˌintəːˈplænitəri/ a. 星际间的

vehicle /ˈviːikl/ n. 交通工具,飞行器,航空器

rigid /ˈridʒid/ a. 坚硬的,刚硬的,严格的

boron /ˈbɔːrɔn/ n. 硼

antimony /ˈæntiməni/ n. 锑

metalloid /ˈmetəlɔid/ n. 准金属,非金属

silicon /ˈsilikən/ n. 硅

germanium /dʒəːˈmeiniəm/ n. 锗

phenomenon /fiˈnɔminən/ (pl. penomena) n. 现象

endeavour /inˈdevə/ n. 尽力

be tied to 被束缚着,被牵制着

distinguishable from 区别于

in a border sence 在广义上

to a lesser extent 在较低程度上,其次

to a great extent 在很大程度上,很

due to 由于,应归于

break up 破碎,破坏

Notes

① Materials are probably more deep-seated in our culture than most of us realize.

材料与我们文明的关系比我们大多数人能意识到的更根深蒂固。

句中 more... than... 比较结构。

② Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fill their needs.

历史上,社会的发展和进步是与人类生产和使用材料来满足他们的需求的能力紧密地联系起来的。

句中 to fill their needs 不定式短语作定语,修饰 materials。

③ The above properties are found not only in pure metals, but also in more complex substances composed of a few metallic elements and sometimes with an admixtute of noticeable quantities of non-metallic elements.

上述性能,不仅纯金属具有,而且由几种金属元素组成的更复杂的物质也具有,有时这些物质还带有一定量的非金属混合物。

句中 not only... but (also)... 并列连词,连结两个句子。译为:不仅……而且……; composed of ... 分词短语作定语,修饰 substances; with 译为"和","与"; noticeable quantities of ... 显著数量的,一定数量的。

④ He discovered that tbe molten metal could be poured into the cavity made by placing together two balves of a hollowed-out clay or stone mould: the metal filled tbe cavity and, when solid, it was found to have taken tbe shape of tbe cavity.

古代的人们发现,将熔化的金属倒进由两个中空的泥做或石头做的半模合在一起形成的一个空腔中,金属能充满空腔,一旦凝固,金属就能形成空腔的形状。

句中 that the molten metal ... 为 that 引导的宾语从句; made by aplcing together... 分词短语作定语,修饰 cavity。

⑤ The art of blending metals was gradually developed and it became known that an "alloy" formed in this may was sometimes stronger, harder, and tougher than the metals of whicb it was composed.

熔合金属的工艺逐渐得到发展,用这种方法形成的"合金"有时比组成它的金属的强度、硬度大,韧性好。

句中 it 为形式主语,that 引导主句从句; formed in this way 分词短语作定语,修饰从句中的 metals; of whicb it was composed 定语从句,修饰 metals. which 前的 of 为 he compodes of 中的 of,可置于关系词前,也可置于从句末。

⑥ In the twentieth century the expansion of the use of metals has been so rapid that considerably more metal has been extracted.

在 20 世纪,金属的使用得到迅速发展,以致于相当多的金属被提炼出来。

句中 so... that... 如此……以致于……, that 引导结果状语从句。

⑦ Our material civilization and every amenity of life depend on the work of the metallurgist and on his ability to produce the right metal for eacb particular purpose.

我们的物质文明和舒适的生活依赖于冶金学家的工作,也依赖于他们生产用于特殊目的的金属的能力。

句中 depend 要求接介词 on,该句中 depend 带了两个 on, 即 depend on the work... 和 depend on his ability...; the right metal 合适的金属。

⑧ While development of tbe new metals is proceeding, fresh endeavours are continually being made to widen the scope of the well known materials.

在新金属不断发展的同时,人们仍在继续做出新的努力,以扩大现有金属的范围。

句中 while 引导状语从句; to widen ... 不定式短语作目的状语。

Questions

1. Have early civilizations been designated by the level of their materials development? Please give some examples.
2. How many types are the solid materials divided into?
3. What is tbe metal?
4. How many metals did Greek civilization know? what are they?
5. Do you know what the first alloy was?
6. What are the characteristics of the semi-metals or metalloids?

Reading Material

Iron and Its Alloys

The earth contains a large number of metals which are useful to man. One of the most important of these is iron.

Iron is a metal of silvery-whitish colour. Its atomic number is 26, its atomic mass① is 55.85, and its atomic radius② is 1.27Å. The purest iron that can be obtained at the present time contains 99.999% Fe. Commercial grades contain from 99.8% to 99.9% Fe. The melting point of iron is 1538℃. Iron exists in two allotropic forms③, α and γ. Alpha-iron exists at temperatures below 912℃ and above 1394℃. In the temperature interval from 1394℃ to 1538℃, α-iron is frequently called δ-iron. The critical point (770℃), corresponding to the magnetic transformation, i.e. transition from a ferromagnetic to a paramagnetic state, is called the Curis point④.

The ancient name for iron is "star metal," prohably because the first iron was extracted from meteorites. Meteorites consist of iron containing about 8 percent of nickle, with a small amount of cobalt. Historically, the largest meteorite, the "Tent", weighs thirty-four tonnes and is composed of an alloy of iron, nickle and cobalt⑤.

Although metal-working was not the first craft known to mankind, our present material civilization is derived from the knowledge and use of metala⑥. Ancient man would probably have described metals as bright substances which were hard but could be hammered into various useful shapes. All the metals which they know were heavy-iron, for examle, being nearly three times as haavy as granite⑦.

The classification of civilization as the stone age, hronze age and iron age depends principally on the kind of tools used. Thousands of years ago men discovered that they could use copper instend of stone to make their tools. Copper was easier to work with than stone and was fairly easy to obtain. Perhaps the only trouble with copper was that it was not hard enough for some uses. About 3500B.C., it was found that if tin, another fairly soft metal, was combined with copper, a very hard material was produced⑧. This matarial was the alloy called bronze. It is much harder than pure copper and much easier to cast in molds. Once bronze bacame available, stone tools began to go out of date⑨. The bronze age did not last long in most civilizations, since the people soon learned how to produce iron which was much harder than hronze and could be sharpened to make better tools and swords.

Copper, tin, zinc, gold, and silver were used long before iron; these metals appeared near the surface of the earth and were easily accessible to⑩ ancient man. The impruities in the ore had to be separated from the iron. The process separating one from the other probably was discovered by accident. The earliest known appearance of iron is a single piece contained in the Great Pyramid⑪ (2900 B.C.). Tools made of iron appeared first in Palestine⑫ (1350 B.C), where an iron furnace was found that dates back to about 1200 B.C. Metal appears also to have been used in ancient China and India about 2000 B. C. The art of smelting seems to have developed somewhere between the year 1350 and 1100 B. C. Prior to that , iron probably was "meteor" iron. Cast iron seems to have made its appearance in China in about 200 B. C.

Iron is not fount in the earth as a metal but only in the form of iron ore which consists of iron and oxygen. Ores that contain iron are magnetite, Fe_3O_4; hematite, Fe O ; siderite, $FeCO_3$; and limonite, Fe_2O_3 plus water⑨. Magnetite is about 65 per cent iron and very strongly magnetic. Hematite is about 50 per cent iron and is capable of being magnetized. Siderite is about 50 per cent iron, whereas limonite is about 60 per cent iron.

Iron is extracted from iron ore by smelting in a blast furnace. Charges of iron ore, coke and limestone are mixed in the correct proportions and fed into the blast furnace. The coke burns to form carbon monoxide, which passes over the iron ore, reducing the iron oxides to metallic iron. The limestone absorbs impurities from the ore and forms a fluid slag which floats on the surface of the heavier molten iron. The iron extracted from the blast furnace is known as pig iron. It contains a number of impurities, including carbon from coke. It is very brittle and difficult to work. Pig iron is converted into steel by removing most but not all of the impurities. This steel is known as the plain carbon steel. A number of alloying elements can be added to steel in order to make it suitable for specialized applications. This is called alloy steel.

Alloy steels are called by the predominating element which has been added⑩. The more common elements added to steel are: chromium, mangnese, molybdenum, nickle, vanadium, tungsten, cobalt, etc.

Iron and its alloys are called ferrous metals. Ferrors metals are dark-gray in colour, have a high density, a high melting point, relatively high hardness, and many of them a polymorphous.

Notes

① atomic mass 原子质量。

② atomic radius 原子半径。

③ allotropic forms 同素异构体。

④ The critical point (770℃), corresponding to the magnetic transformation, i. e. transition from a ferromagnetic to a paramagnetic state, is called the Curis point.

对应于磁性转变，即从铁磁性状态到顺磁性状态的转变临界点(770℃)称为居里点。

句中 corresponding to 与……相符，相当于，对应于；分词短语作定语。transition from... paramagnetic state 为主语 the critical point (770℃)的同位语。

⑤ Historically, the largest meteorite, the "Tent", weighs thirty-four tonnes and is composed of an alloy of iron, nickle and cobalt.

历史上，最大的陨石"帐蓬"重达 34t，由铁、镍和钴三者的合金构成。

句中主语为 the largest meteorite，带二个谓语 weights 和 is composed of。

⑥ Although metal-working was not the first craft known to mankind, our present material civilization is derived from the knowledge and use of metals.

虽然金属加工不是人类懂得最早的生产技术，但是，我们目前的物质文明却起源于人们对金属的了解和使用。

句中 although 引导让步状语从句，be derived from 由……而来，起源于……。

⑦ All the metals which they know were heavy-iron, for example, being nearly three times as heavy as granite.

古代人们所知道的金属都很重，例如，铁的重量几乎是花岗石的三倍。

句中 which 引导定语从句，修饰 metals; being nearly... 分词短语作补充说明。

⑧ About 3500 B.C., it was found that if tin, another fairly soft metal, was combined with copper, a very hard material was produced.

在公元前 3500 年左右，当时发现，如果另一种相当软的金属锌与铜结合，能形成一种非常硬的材料。

句中 it 为形式主语，真正的主语为 that 引导的主语从句，在主语从句中还带有一个由 if 引导的条件状语从句。

⑨ out of date 过时。

⑩ accessible to 易接近的。

⑪ Great Pyramid 大金字塔。

⑫ Palestine 巴勒斯坦。

⑬ Ores that contain iron are magnetite, Fe_3O4, hematite, FeO; siderite, $FeCO_3$; and limonite, Fe_2O_3 plus water.

含有铁的矿石是磁铁矿 Fe_3O_4；赤铁矿 FeO；菱铁矿 $FeCO_3$；褐铁矿 Fe_2O_3，并附加水分。

句中 that 引导定语从句。

⑭ Alloy steels are called by the predominating element which has been added.

合金钢按其中加入的主要合金元素来命名。

句中 which 引导定语从句，修饰 element。

Unit 2. Metals and Ferrous Metals

Metals are divided into two general types — ferrous and nonferrous. Ferrous metals are those which contain iron. Nouferrous metals are those[①] which do not contain iron. However, some nonferrous metals may contain a small amount of iron as an impurity.

Steel and cast iron are the most common ferrous metals in general use. Steel is an alloy containing chiefiy iron, carbon, and certain other elements in varying amounts. A wide range of physical properties may be obtained in steel by controlling the amount of carbon and other alloying elements and by subjecting the steel to various heat treatments.

Plain carhon steels usually contain, besides iron and carbon, small amounts of silicon, sulphur, phosphorus, and manganese. Alloy steels are formed by the addition of one or more of the following elements: nickel, chromium, molybdenum; vanadium, tungsten, manganese, silicon, and small amounts of other alloying elements.

Carbon is by far the most important alloying element in steel. It is the amount of carbon present which largely determines the maximum hardness obtainable. The higher the carbon content, the higher the tensile strength and the greater the hardness to which the steel may be heat-treated. ②

1. Carbon Steels

Carbon steels are classified according to the percentage of carbon they contain. They are referred to as low, medium, and high carbon steels.

Steels with a carbon range of 0.05 to 0.25 per cent are called low carbon steels. Steels in this class are tough, ductile, and easily machined, formed, and welded. Most of them do not respond to any heat treating process except case hardening.

Medium carbon steels have a carbon range from 0.25 to 0.60 per cent. They are strong and hard but cannot be worked or welded as easily as low carbon steels. Because of their higher carbon content, they can be heat treated. Successful welding of these steels often requires special electrodes, but even then greater care must be taken to prevent formation of cracks around the weld area. ③ It is used for many standard machine parts. In the school shop it is used for projects like hammer heads and clamp parts.

Steels with a carbon range of 0.60 to 1.7 per cent are classified as high carbon steels. These steels respond well to heat treatment. It is used for making small tools or for any item that must be hardened and tempered.

2. Alloy Steels

Alloy steels have special properties determined by the mixture and the amount of other metals added. To the metallurgist who works in metal mining and manufacturing, steels containing very small quantities of elements other than carbon, phosphorus, sulphur, and silicon are known as alloy steels. Each alloy steel has a personality of its own. A car is made of about 100 different kinds of alloy steel.

Low-alloy steels are those steels tbat do not contain more than 5% of any alloying metal or in which the total alloy content does not greatly exceed 5%. Such steels are used principally for applications requiring either toughness or great strength, or sometimes for heat or corrosion resistance. High-alloy steels, which contain more than 10% alloy, are used in applications where heat or corrosion resistance are the dominant requirements.

Tool-and-die steels are a large group of steels used when careful heat-treating must he done. These steels are used for parts such as chisels, hammers, screwdrivers, springs, and tools and dies used to cut and form metals. ④

Tool steels with certain alloying elements are designed for specific uses. The most common kinds of tool steels include high-speed tool steels, hot work tool steels, cold work tool steels and special-purpose tool steels.

3. Cast iron

Cast iron is used for the heavy parts of many machines. Cast iron is low in cost and wears well. It is very brittle, however, and cannot be hammered or formed. It contains 2 to

4 percent carbon. The basic kinds of cast iron are white iron, gray iron, and malleable iron.

White cast iron is the hardest type of cast iron. It is unweldable.

The commonest type of cast iron is gray cast iron, an alloy of iron and carbon containing about 3% to 3.5% carbon, and more than 1% silicon. These are large amounts of carbon and silicon, and in these proportions all the carbon is not taken up by the iron as iron carbide.⑧ A part of this carbon separates out as graphite flakes distributed throughout the cast iron. These graphite flakes give a characteristically dark appearance to a freshly broken surface of gray cast iron.

Gray cast iron has little ductility, and can sustain high compressive loads.

Nodular iron is a variation of gray cast iron, and has a microscopic structure that overcomes most of the limitations of gray cast iron. Nodular iron likewise contains graphite, but the iron is inoculated with a small amount of magnesium while being poured into the ladle. As a result the graphite becomes nodular or approximately spherical. The result is a cast iron with excellent ductility and tensile strength. Nodular iron is a kind of cast iron that is even better for withstanding shocks, blows, and jerks.

Malleable iron is a particular kind of cast iron, made more malleable by an annealing procedure. Malleable-iron castings are not so brittle or hard. They can stand a great deal of hammering. Many plumbing fixtures are made of malleahle iron.

New Words and Expressions

ferrous /ˈferəs/ a. 含铁的，亚铁的 (—metal 黑色金属)

nonferrous /nʌnˈferəs/ a. 非铁的 (—metal 有色金属)

impurity /imˈpjuəriti/ n. 杂质，混杂物

cast /kɑːst/ vt. 铸造；n. 铸型，铸件

sulphur /ˈsʌlfə/ n. 硫

phosphorus /ˈfɔsfərəs/ n. 磷

manganese /mæŋgəˈniːz/ n. 锰

nickel /ˈnikl/ n. 镍

chromium /ˈkroumjum/ n. 铬

molybdenum /mɔˈlibdinəm/ n. 钼

vanadium /vəˈneidjəm/ n. 钒

tensile /ˈtensɑil/ a. 抗拉的，抗张的，拉力的

tough /tʌf/ a. 韧性的，坚韧的；(-ness) n. 韧性，塑性

ductile /ˈdʌktɑil/ a. 可延展的，可塑的；ductility n. 延展性

weld /weld/ vt. 焊(接)，熔焊；n. 焊接，熔焊

electrode /iˈlektroud/ n. 电焊条，电极

crack /kræk/ vt. 敲碎，弄裂；vi. 破裂；n. 裂缝

clamp /ˈklæmp/ n. 夹钳，夹具

temper /ˈtempə/ vt. 回火；n. 回火色

harden /ˈhɑːdn/ vt. 使硬化，淬火

mining /ˈmɑiniŋ/ n. 采矿，矿业

personality /ˌpəːsəˈnæliti/ n. 个性，人格，品格，人物

penetration /peniˈtreiʃən/ n. 渗透，穿透

chisel /ˈtʃizl/ n. 凿子，錾子

screwdriver /skruːˈdrɑivə/ n. 一字(或十字)旋具

spring /spriŋ/ n. 弹簧

die /dɑi/ n. 木模，冲模，压模

malleable /ˈmæliəbl/ a. 可锻的，可延展性的

graphite /ˈgræfɑit/ n. 石墨

flake /fleik/ n. 薄片，鳞片，小片

compressive /kəm'presiv/ a. 压缩的
nadular /'nɔdjulə/ a. 结核状的
(—cast iron) 球墨铸铁
microscopic /ˌmaikrəs'kɔpik/ a. 显微镜的，微观的，微小的
sphercial /'sferikəl/ a. 球形的，球的
be divided into ……可分为……
a wide range of 各式各样的，大量的
subjuct to 受到，经受
a small amout of 少量的
by far （十形容词最高级或比较级）非常……，更加……得多，最……
be known as 被称为，以……著称
be combined with 与……化合，与……结合
be made of 由……制成
according to 按照
be referred to as 称为
be classified as 将……分成

Notes

① those 是 that 的复数，这里代替 ferrous metals，以避免重得。

② The ＋比较级，the ＋比较级 and the ＋比较级越……越……，并且越……。

③ Successful welding of these steels often requires special electrodes, but even then greater care must be taken to prevent formation of cracks around the weld area.

要使这种钢顺利焊接需要使用特殊焊条，但是，即使这样，还须更加小心保护，以防在焊缝处产生裂纹。

句中 even then 甚至在这种情况下；即使这样。句中 great care must be taken to（＋动词原形）须更加小心（做）。

④ tools and dies... metals 句中 used to cut and form metals 是一个过去分词短语，作 tools and dies 的定语。

⑤ ...all...is not 一切……不都是；不是所有的……都。

句中 is taken up by the iron as iron carbide 同铁化合成碳化铁。

Questions

1. How many basic groups can metals be devided into?
2. Which elements do plain carbon steels contain?
3. Which alloying elements do alloy steels contain?
4. How many kinds are carbon steels classified by the amout of carhon they contain? What are their main uses?
5. How many kinds of cast irons are there?

Reading Material

Non-ferrous Metals and Their Alloys

Non-ferrous metals are, by definition, metals other than iron; that are used extensively in the unalloyed condition, or as the base of alloys①. This group includes aluminium, copper, lead, magnesium, nickel, tin, titanium, and zinc.

1. Aluminium and Aluminium alloys

(1) Aluminium (chemical symbol Al) Aluminium is very weak and very ductile, and melts at 660℃. It is an important engineering metal because it is light (its density is approximately one-third that of iron) and does not suffer deterioration as a result of② atmospheric

corrosion, as the oxide film insulates it against continued attack. Its tensile strength is only about 60 N/mm^2, but this can be increased by cold-working. Aluminium has high electrical and thermal conductivity, and a high coefficent of thermal expansion. It can be polished to reflect light and heat. It is used mainly as the base of reasonably strong and light alloys.

(2) Aluminium alloys Alloying elements are added to aluminium to produce stronger materials and to improve its casting properties. Copper, manganese, magnesium, zinc, nickel, and silicon are the most important alloying elements used.

Aluminium alloys are classed according to the method whereby they can be manipulated into③ shape, i.e. wrought aluminium alloys and casting aluminium alloys. Within these two groups, alloys are further classified according to whether they respond to heat-treatment of the strengthening type.

Wrought alloys of the 'non heat-treatable' type can be made stronger as a result of work hardening.

Aluminium alloys of the heat-treatable type can be hardened by a process that is two-part. The first part, called solution-treatment, consists of heating the alloy to a temperature of about 490℃, and then quenching it in water or oil. Immediately after this treatment, the alloy will be very soft and ductile, and be cold-worked with case.

The second part depends upon the composition of the alloy. Some alloys will start to become harder and stronger a few hours after the quenching, and reach their maximum strength after about three days standing at room temperature. This process is called age-hardening.④

Casting aluminium alloys contain rather large quantities of silicon or magnesium, to produce a lower melting-point alloy.

2. Copper and Copper alloys

(1) Copper (chemical symbol Cu) Copper is very weak and ductile, and melts at 1083℃. It has a high thermal and electrical conductivity, and a good resistance to corrosion. Copper has a tensile strength of about 160 N/mm^2, and an elongation of about 50%. Cold-working increases its strength but reduces its ductility. The ductility can be increased at the expense of hardness and strength by annealing; a range of so-called 'temper' can ha produced by controlling the extent of working after annealing. Copper and its alloys can easily be joined by soldering, brazing, and welding; and are used extensively in engineering, in spite of the high cost of copper.

(2) Copper alloys

1) Brasses. Zinc is alloyed with copper to form a range of alloys called brasses. The properties of brass vary considerahly with the zinc content. It will be seen that the ductility is a maximum when the zinc content is 30%, and falls sharply with further increases in the zinc content. The melting-point is lowered by increases in the zinc content. Brasses with less than about 37% zinc are suitable for cold-working, and those with between about 37% and 45% zinc are suitable for hot-working and casting.