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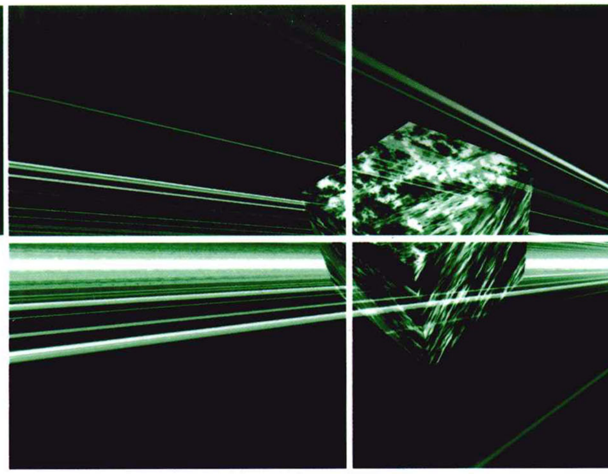

塑性成形与模具专业英语

宋建丽　主编

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普通高等教育“十二五”规划教材

塑性成形与模具专业英语

Specialized English on Plastic Forming and Dies (Moulds)

主　编　宋建丽

副主编　曹晓卿　郭俊卿

参　编　王鹏程　刘　岩　刘德宝　陈革新

主　审　王新云

机 械 工 业 出 版 社

本书共13章，内容主要包括常用工程材料及热处理基础，金属塑性成形基础，锻造、轧制工艺及模具，挤压、拉拔工艺及模具，板料成形工艺及模具，常用模具材料及热处理，塑料成形工艺及模具，金属铸造工艺与模具，模具材料与寿命，金属和塑料成形设备，模具制造方法及模具CAD/CAM/CAE等。本书较全面地介绍了传统的塑性成形工艺与模具方面的知识，又兼顾了先进的塑性成形工艺与模具的制造工艺及方法。每节后都附有专业词汇、词组及注释。本书图文并茂，基本工艺、原理和结构、设备等大多附有图示说明，以利于学生阅读和理解课文，记忆和掌握专业词汇和术语。此外，本书还附有科技英语的特点及翻译方法与技巧、科技论文摘要写作介绍等方面的有关内容，可帮助学生提高阅读和翻译能力。

本书可作为高等院校材料成形及控制工程专业的本科生教材，也可作为相关专业的研究生教材，或供从事塑性成形及模具加工生产与研究开发工作的工程技术人员参考。

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前　言

本书是编者根据多年从事塑性成形与模具方向专业英语教学的经验编写而成的，可作为高等院校材料成形及控制工程专业的本科生及研究生教材，也可供从事塑性成形及模具加工生产与研究开发工作的工程技术人员参考。

本书共13章，内容主要包括常用工程材料及热处理基础，金属塑性成形基础，锻造、轧制工艺及模具，挤压、拉拔工艺及模具，板料成形工艺及模具，常用模具材料及热处理，塑料成形工艺及模具，金属铸造工艺与模具，模具材料与寿命，金属和塑料成形设备，模具制造方法及模具CAD/CAM/CAE等。此外，本书还附有科技英语的特点以及写作和翻译的方法与技巧等方面的有关内容，可帮助学生提高阅读和翻译能力。本书内容不仅较全面地概括了传统的塑性成形工艺与模具方面的知识，还介绍了先进的塑性成形工艺与模具的制造工艺及方法。每节后都附有专业词汇、词组及注释。本书图文并茂，基本工艺、原理、结构和设备等大多附有图示说明，以利于学生阅读和理解课文，记忆和掌握专业词汇和术语，掌握学科前沿动态。

本书第1章和第7章由太原科技大学刘岩教授编写，第2章和第13章由天津理工大学刘德宝副教授编写，第3章和第4章由太原科技大学宋建丽教授编写，第5章和第12章由内蒙古工业大学王鹏程教授编写，第6章和第9章由太原理工大学曹晓卿教授编写，第8章和第10章由河南科技大学郭俊卿副教授编写，第11章由燕山大学陈革新讲师编写。本书由宋建丽教授任主编并统稿，曹晓卿教授及郭俊卿副教授任副主编，华中科技大学王新云教授任本书的主审。

本书从网络页面及课件中获得了大量的参考资料，在此一并向作者表示感谢。

由于编者水平有限，书中的错误和疏漏之处在所难免，敬请读者批评指正。

编　者

CONTENTS

CHAPTER 1 FUNDAMENTALS OF MATERIALS

1.1 Metals and Nonmetals

Perhaps the most common classification that is encountered in materials selection is whether the material is metallic or nonmetallic[1]. The common metallic materials are such metals as iron, copper, aluminum, magnesium, nickel, titanium and the alloys of these metals, such as steel, brass and bronze. They possess the metallic properties of luster, thermal conductivity and electrical conductivity; they are relatively ductile and some of them have good magnetic properties. The common nonmetals are wood, brick, concrete, glass, rubber and plastics. Their properties vary widely, but they generally tend to be less ductile, weaker and less dense than the metals, and they have no electrical conductivity and poor thermal conductivity.

About two thirds of all elements found in the earth are metals, but not all metals may be used in industry[2]. Those metals, which are used in industry, are called engineering metals. The most important engineering metal is iron (Fe), which in the form of alloys with carbon (C) and other elements, finds greater use than any other metals. It is known that metals are very important in our life. Metals have the greatest importance for industry. All machines and other engineering constructions have metal parts; some of them consist only of metal parts.

Why does man use metals still so much today when there are other materials, especially plastics, which are available? A material is generally used because it offers the required strength and other properties at minimum cost. Appearance is also an important factor. The main advantage of metals is their strength and toughness. Concrete may be cheaper and is often used in building, but even concrete depends on its core of steel for strength. Plastics are lighter and more corrosion-resistant, but they are not usually as strong. Another problem with plastics is what to do with them after use. Metal objects can often be broken down and recycled; plastics can only be dumped or burned.

Plastics have specific properties, which may make them preferable to traditional materials for certain uses[3]. In comparison with metals, for example, plastics have both advantages and disadvantages. Metals tend to be corroded by inorganic acids, such as sulphuric acid and hydrochloric acid. Plastics tend to be resistant to these acids, but can be dissolved or deformed by solvents, such as carbon tetrachloride, which have the same carbon base as the plastics. Color must be applied to the surface of metals, whereas it can be mixed in with plastics. Metals are more rigid than most plastics, while plastics are very light, with a specific gravity normally between 0.9 and 1.8. Most plastics do not readily conduct heat or electricity. Plastics soften slowly and can easily be shaped while they are soft.

Their plasticity at certain temperatures gives plastics their main advantage over many other materials. It permits the large-scale production of molded articles, such as containers, at an economic unit cost[4], where other materials require laborious and often costly processes involving cutting, shaping, machining, assembly and decoration. A plastics article may need to differ in design and appearance from a similar article made from another material such as metal or wood. This is due not only to the properties of plastics but also to the techniques employed in fabricating plastics products. These techniques include injection molding, blow molding, compression molding, extrusion and vacuum forming.

Although it is likely that metals always will be the more important of the two groups, the relative importance of the nonmetallic group is increasing rapidly, and since new nonmetals are being created almost continuously, this trend is certain to continue. In many cases, the selection between a metal and nonmetal is determined by a consideration of required properties. Where the required properties are available in both, total cost becomes the determining factor[5].

Vocabulary

metallic *adj.* （含）金属（制）的
aluminum *n.* 铝
magnesium *n.* 镁
nickel *n.* 镍
titanium *n.* 钛
alloy *n.* 合金
brass *n.* 黄铜
bronze *n.* 青铜（器）
luster *n.* 光泽
ductility *n.* 延展性，可锻性
concrete *n.* 水泥
plastics *n.* 塑料
density *n.* 密度
carbon *n.* 碳
appearance *n.* 外表，外观
toughness *n.* 韧性
corrosion *n.* 腐蚀
recycle *v.* 反复（循环）利用
dump *v.* 倾倒，堆放
inorganic acid 无机酸
sulphuric acid 硫酸
hydrochloric acid 盐酸
solvent *n.* 溶剂 *adj.* （有）溶解（力）的
carbon tetrachloride 四氯化碳
rigid *adj.* 坚硬的，刚性的 *n.* 刚度
mould（mold） *n.* （注塑、压塑、铸造用）模子 *v.* 模塑，压制，铸型
plasticity *n.* 塑性
cutting *n.* 分离，切断
shaping *n.* 成形
machining *n.* 机加工，切削
assembly *n.* 装配
decoration *n.* 装饰，涂漆
fabricate *vt.* 制造（备），生产
injection molding 注射模塑（法）
blow molding 吹塑（法）
compression molding 压塑（法），模压（法）
extrusion *n.* 挤压
vacuum forming 真空模塑（法）
it is certain to（inf.） 必然，一定

Notes

[1] Perhaps the most common classification that is encountered in materials selection is whether the material is metallic or nonmetallic. 本句中，that is encountered ... selection 为 classification 的定语从句；whether ... or ... “是……还是……”，引导表语从句。全句译为：“在选择材料时所遇到的最普遍的分类问题，大概是这种材料是金属材料还是非金属材料。”

[2] About two thirds of all elements found in the earth are metals 中，found in the earth 是过去分词短语，做 all elements 的后置定语，可译为“地球上发现的各种元素……”，而 two thirds 是指“三分之二”，故全句可译为：“在地球上发现的各种元素中，大约三分之二是金属元素，但并不是所有的金属都能够用于工业上。”

[3] Plastics have specific properties, which may make them preferable to traditional materials for certain uses. 句中，which 引出定语从句说明 properties，而介词 to 表示对比之意，故本句可译为：“塑料具有特殊性能，这就使其在某些用途上比传统材料更为可取。”

[4] It permits the large-scale production of molded articles, such as containers, at an economic unit cost. such as 被两个逗号隔开，是一种举例注释，而 articles 后面有介词短语 at an economic unit cost 做其后置定语，意思是“单位成本便宜的零件”。故本句可译为：“塑料的塑性使之能大量地生产单位成本低的模塑制件，例如各种容器等。”

[5] Where the required properties are available in both, total cost becomes the determining factor. 句中 Where 引导状语从句，意思是 in case（在……情况下）；available 是“可以得到的”。本句可译为：“在两种材料都能满足需要时，总成本就成了决定性因素。”

1.2　Ferrous Metals, Nonferrous Metals and Alloys

Metals consisting of iron combined with some other elements are known as ferrous metals[1]; all the other metals are called nonferrous metals. The most important nonferrous metals are copper (Cu), aluminum (Al), lead (Pb), zinc (Zn), tin (Sn), but all these metals are used much less than ferrous metals, because the ferrous metals are much cheaper. This means that there are an enormous variety of metals and metallic materials available from which to choose.

Not all metals are strong. Copper and aluminum, for example, are both fairly weak, but if they are mixed together, the result is an alloy called aluminum bronze, which is much stronger than either pure copper or pure aluminum. Alloying is an important method of obtaining whatever special properties are required: strength, toughness, resistance to wear, magnetic properties, high electrical resistance or corrosion-resistance[2].

Methods of extracting, producing and treating metals are being developed all the time to meet engineering requirements. Different metals are produced in different ways, but almost all the metals are found in the form of metal ore (iron ore, copper ore, etc.). The ore is a mineral consisting of a metal combined with some impurities. In order to produce a metal from some metal ore, these impurities must be separated from the metal, which is done by metallurgy.

Casting is a widely used method of producing metal products, particularly those which are intricate.

Since molten materials will readily take the shape of the container into which they are poured, it is nearly as easy to cast fairly complex shapes as to produce simple forms. The metals most frequently cast are iron, steel, aluminium and so on. Of these, iron, because of its low melting point, low price and ease of control, is outstanding for its suitability for casting and is used far more than all the others.

A relatively wide range of nonferrous alloys can be die-cast. The principal base metals used, in order of commercial importance, are zinc, aluminium, copper, magnesium, lead and tin. The alloys may be further classified as low-temperature alloys and high-temperature alloys; those having a casting temperature below 538 °C, such as zinc, tin and lead, are in the low-temperature class. The low-temperature alloys have the advantages of lower cost of production and lower die-maintenance costs. As the casting temperature increases, alloy and other special steels in the best treated condition are required to resist the erosion and heat checking of die surfaces[3]. The destructive effect of high temperatures on the dies has been the principal factor in retarding the development of high-temperature die-castings.

Another factor governing the choice of alloy is the erosive or solvent action of the molten metal on the respective machine parts and dies. This action increases with temperature, although it is more pronounced with some alloys than with others. Aluminium, in particular, has a destructive action on ferrous metals and, for this reason, is seldom melted in the machine, whereas the copper-base alloys are never melted in the machine.

Aluminum alloys are best known for low density and corrosion resistance. Electrical conductivity, easy of fabrication and appearance are also attractive features. Magnesium alloys have even lower density than aluminum and, as a result, appear in numerous structural applications such as aerospace designs. Aluminum is an fcc material and therefore has numerous slip systems, leading to good ductility. By contrast, magnesium is hcp with only three slip systems and characteristic brittleness. Although more dense than Al or Mg, titanium alloys have a distinct advantage of retaining strength at moderate service temperatures, leading to numerous aerospace design applications. Titanium shares the hcp structure with magnesium leading to characteristically low ductility. However, a high temperature bcc structure can be stabilized at room temperature by certain alloy additions such as vanadium. Copper alloys possess a number of superior properties. The fcc structure contributes to their generally high ductility and formability. The mechanical properties of these alloys rival the steels in their variability.

Vocabulary

ferrous *adj.* （含）铁的

ferrous metal 黑色金属

nonferrous metal 有色金属

lead *n.* 铅

zinc *n.* 锌

tin *n.* 锡

extract *vt.* 提炼，萃取

ore *n.* 矿（石）

mineral *n.* 矿物 *adj.* 矿物的

retard *vt.* （使）延缓 *n.* 推迟

copper-base alloy 铜基合金

fcc （face-centered cubic）面心立方

hcp （hexagonal close-packed）密排六方

impurity *n.* 杂质，不纯

metallurgy *n.* 冶金（术）
casting（s） *n.* 铸造（件）
die-casting（s） *n.* 压铸（件）
molten *adj.* 熔（融、化）的
pour *v.* 浇注
erosion *n.* 腐（侵、烧）蚀
heat checking 热裂纹，龟裂
destructive *adj.* 破坏（性）的，有害的
bcc （body-centered cubic）体心立方
stabilize *vt.* 使稳定，使坚固
vanadium *n.* 钒
formability *n.* 成形性
rival *n.* 对手 *v.* 与……相匹敌

Notes

[1] Metals consisting of iron combined with some other elements are known as ferrous metals. 其中，consisting of 是短语动词的现在分词形式，与后面的宾语组成现在分词短语做 Metals 的后置定语。本句的谓语是 are known as。因此本句可译为："由铁跟某些其他元素结合组成的金属称为黑色金属。"

[2] Alloying is an important method of obtaining whatever special properties are required: strength, toughness, resistance to wear, magnetic properties, high electrical resistance or corrosion-resistance. 其中，从句 whatever special properties are required 是 obtaining 的宾语。全句可译为："合金化是获得所需的各种特殊性能的一种重要方法，如强度、韧性、抗磨性、磁性、高电阻率及耐蚀性。"

[3] As the casting temperature increases, alloy and other special steels in the best treated condition are required to resist the erosion and heat checking of die surfaces. 句中，in the best treated condition 是介词短语，做 alloy and other special steels 的定语，表示"在最优条件下处理过的合金钢和其他特种钢"；而 sb. /sth. is required to + inf.，意为"某人或某物被要求去……"。因此本句可译为："当铸造温度上升时，需要用经过最佳处理的合金钢和其他特种钢来抵抗对模具表面的熔蚀和热裂纹。"

1.3 Polymers

1.3.1 Polymers

There is no generally accepted definition of a plastic, but it can be regared as a material containing a synthetic high polymer as the major constituent. Polymers are materials of high molecular weight formed by joining together many (poly) small molecules. In some plastics the polymer may be the only constituent, but more usually a variety of other substances are incorporated such as fillers, pigments, antioxidants, plasticizers, etc. These additives will enhance specific properties and/or facilitate processing. Almost all commercial plastics at present are based upon organic polymers. The word plastics is closely associated in many minds with cheap, brightly coloured products of limited life. The time has probably come to adapt a new name more worthy of the exciting range of polymer materials with many different properties which are available to engineers[1].

From the production point of view, the main advantage of plastic materials is their relatively low melting point and their ability to flow into a mould. Generally there is only one production operation required to convert the chemically manufactured plastic into a finished article. Contrast this with metal where generally many operations are required to convert the raw material into its final shape [2].

It is convenient to divide plastics into two groups depending upon the geometrical form of the polymer molecule. The first group is the linear polymers which are the basis of thermoplastics.

1.3.2 Thermoplastics

In linear polymers the molecules are synthesized in the shape of long threads. They are called thermoplastics because they soften upon heating and harden upon cooling in a reusable fashion. In the melted state they are rubber-like liquids, and in the hard state they are glassy and brittle (e.g. Perspex) or partially crystalline (e. g. Nylon). The latter type decreases in volume upon solidification by several percent which must be taken into account during processing[3].

Properties of some of the thermoplastics are given below in the table 1-1.

Table 1-1 Properties of thermoplastics

Polymer	Tensile Strength	Compressive Strength	Machining Properties	Chemical Resistance
Nylon	Excellent	Good	Excellent	Good
PTFE (Poly-tetra-fluoro-ethylene)	Fair	Good	Excellent	Outstanding
Polypropylene	Fair	Fair	Excellent	Excellent
Polystyrene	Excellent	Good	Fair	Fair
PVC (Polyvinyl-chloride) (rigid)	Excellent	Good	Excellent	Excellent
PVC (flexible)	Fair	Poor	Poor	Good

- Tensile Strength: Excellent 55 N/mm^2 Poor 21 N/mm^2.
- Compressive Strength: Excellent 210 N/mm^2 Poor 35 N/mm^2.

Thermoplastics can be processed to their final shape by plastic moulding or extruding. Extruding is often used as an intermediate process to be followed by vacuum forming or machining, for example. We will consider each of these processes in turn.

1.3.3 Thermosetting Plastics

These polymers set solid after being melted to a liquid state by heating; hence the term thermosetting plastic. This process of solidifying is known as curing. During curing, all the small molecules are chemically linked together to form one giant network molecule. Hence they are distinguished from the linear polymers (thermoplastics) by being called network polymers.

The change from the liquid state to solid is irreversible and further heating results only in chemical breakdown; not melting. All the common thermosetting plastics are synthetic resins like epoxide, melamine, phenol, polyester for example, which in the hard state are invariably glassy and brittle in nature. Their structures are based upon carbon like the linear polymers. The silicones, however, are another family of materials whose structure is based upon silicon, not carbon. They are usually grouped with the common thermosetting plastics, the properties of some of which are given below in the table shown at table 1-2. It will be noticed that fillers are given below in the table to improve or modify the mechanical or chemical properties of the resin, or in order to give cheaper materials.

Thermosetting plastics are processed to their final shape by moulding. This may be followed in some instances by machining. We will consider each of these processes in turn.

Table 1-2 Properties of thermosetting plastics

Polymer	Tensile Strength	Compressive Strength	Machining Properties	Chemical Resistance
Epoxy Resin (glass fibre filled)	Outstanding	Excellent	Good	Excellent
Melamine Formaldehyde (asbestos filled)	Good	Good	Fair	Good
Phenol Formaldehyde (bakelite)	Good	Good	Fair	Fair
Polyester (glass fibre filled)	Excellent	Good	Good	Fair
Silicone (asbestos filled)	Outstanding	Good	Fair	Fair

- Tensile Strength: Excellent 55 N/mm^2 Poor 21 N/mm^2.
- Compressive Strength: Excellent 210 N/mm^2 Poor 35 N/mm^2.

Vocabulary

polymer *n.* 聚合物，多聚物
linear polymer 线状聚合物
network polymer 网状聚合物
thermoplastic 热塑性塑料
thermosetting plastic 热固性塑料
synthetic *adj.* 合成的，人造的
constituent *n.* 组成部分，成分
filler *n.* 添加物，填料
pigment *n.* 颜色，颜料
antioxidant *n.* 防氧化剂
plasticizer *n.* 增塑剂
facilitate *v.* 使容易，便于
in one's mind 在……心目中，照……的看法
raw *adj.* 原始的，未加工的
perspex *n.* 有机玻璃
crystalline *n.* 结晶，晶状体
nylon *n.* 尼龙
solidification *n.* 凝固，固化，结晶
compress *v.* 压缩
PTFE (poly-tetra-fluoro-ethylene) *n.* 聚四氟乙烯
polypropylene *n.* 聚丙烯
PVC (polyvinyl-chloride) *n.* 聚氯乙烯
polystyrene *n.* 聚苯乙烯
moulding *n.* 模压，模具成形
curing *n.* 硫化，熟化，固化
irreversible *adj.* 单向的，不可逆的
resin *n.* 树脂，树脂制品
epoxide *n.* 环氧化物
epoxy resin 环氧树脂
melamine *n.* 蜜胺，三聚氰（酰）胺
formaldehyde *n.* 甲醛
asbestos *n.* 石棉
phenol *n.* （苯）酚
bakelite *n.* 胶木，电木；酚醛塑料
polyester *n.* 聚酯
silicone *n.* （有机）硅（树脂）

Notes

[1] The time has probably come to adapt a new name more worthy of the exciting range of polymer materials with many different properties which are available to engineers. 句中，to adapt a new name more worthy of 为不定式短语，意为“使用一个与……价值更适应的新名字”，which 引导定语从句说明 properties。本句可译为：“工程师们已经能获得各种不同性能的聚合材料，因此使用一个与该领域激动人心的发展相适应的新名字的时候可能已经来临”。

[2] Generally there is only one production operation required to convert the chemically manufactured plastic into a finished article. Contrast this with metal where generally many operations are required to convert the raw material into its final shape. 本句中，contrast M with N 表示把 M 与 N 相比较，contrast 为谓语动词，where 引导定语从句修饰 metal。全句译为：“把塑料加工与金属加工相对照，在金属加工中，原材料获得最终形状通常需要许多工序。”

[3] The latter type decrease in volume upon solidification by several percent which must be taken into account during processing. 句中，the latter type 是指热塑性塑料凝固时，decrease by... 是“减少额、缩小量”，which 引导定语从句修饰 several percent。故此句译为：“热塑性塑料凝固时体积会缩小百分之几，这必须考虑到加工工艺之中。”

1.4 Mechanical Properties of Materials

One material can often be distinguished from another by means of physical properties, such as color, density, specific heat, coefficient of thermal expansion, thermal and electrical conductivity, magnetic properties and melting point. Some of these, for example, thermal conductivity, electrical conductivity and density, may be of prime importance in selecting material for certain specific uses. Those properties that describe how a material reacts to mechanical usage, however, are often more important to the engineer in selecting materials in connection with design [1]. These mechanical properties relate to how the material will react to the various loading during service.

Mechanical properties are the characteristic responses of a material to applied forces. These properties fall into five broad categories: strength, hardness, elasticity, ductility (plasticity) and toughness.

Strength is the ability of a material to resist applied forces[2]. Elevator cables and building beams must have this property.

Hardness is the ability of a material to resist penetration and abrasion. Cutting tools must resist abrasion, or wear. Metal rolls for steel mills must resist penetration.

Elasticity is the ability to spring back to original shape. All springs should have this quality.

Ductility (plasticity) is the ability to undergo permanent changes (plastic deformation) of shape without rupturing. Stamped and formed products must have this property.

Toughness is the ability to absorb mechanically applied energy. Strength and ductility determine a material's toughness. Toughness is needed in railroad cars, automobile axles, hammers and similar products.