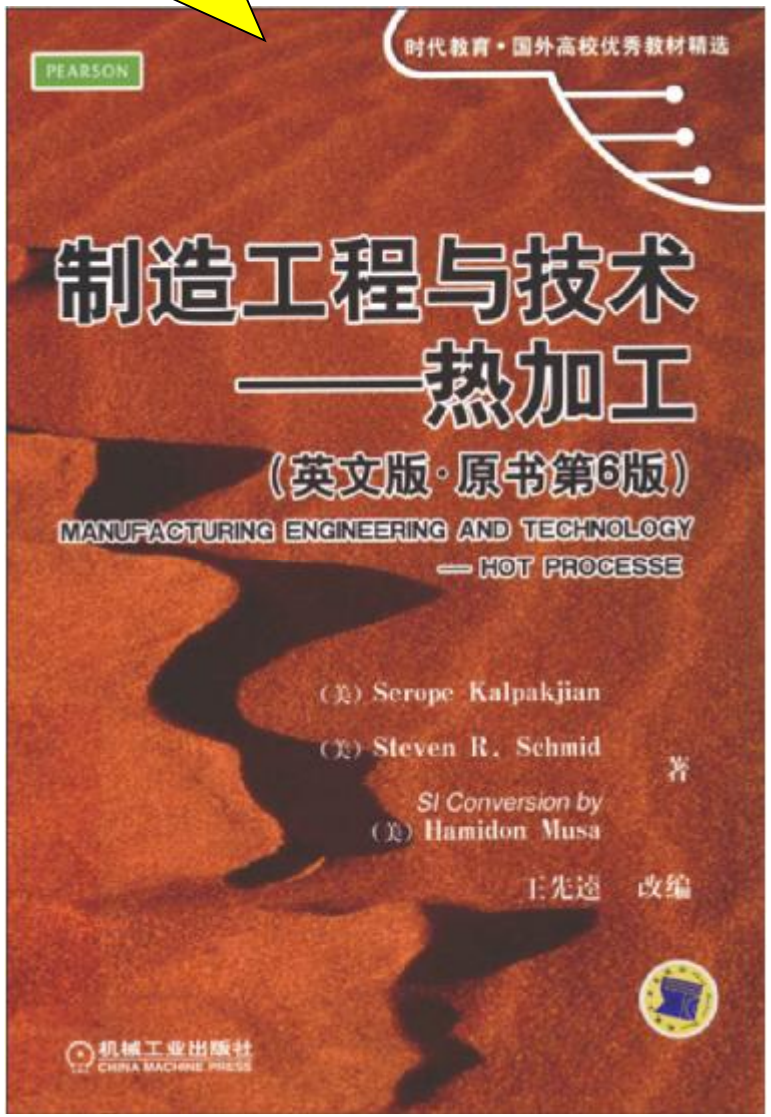
# Manufacturing Engineering and Technology -Hot Process

**The 6th Edition**
**Current textbook**




**The 4th Edition**
**Earlier textbook**

# Bilingual Course（双语课程）

- 教材及课件： **English**
- 讲解：中文
- 要求掌握：专业知识+英语
- 考试及作业：**English**
- 考核方式：闭卷（选择、填空、判断）50%

  开卷（问答）50%
- 总评成绩：考试成绩70%+平时成绩30%（出勤与作业）
- 学习方法： 课程内容的理解+课后复习、作业

理解掌握

背单词+理解

# PART II

# Forming and Shaping Processes and Equipment

# (*成形/成型*工艺与设备）

- **We generally tend to take for granted many of the products that we use, or that we come across every day, and the materials and components from which they are made.**
- **When we inspect these products, we soon realize that a wide variety of materials and processes have been used to make them (Fig. III. 1).**

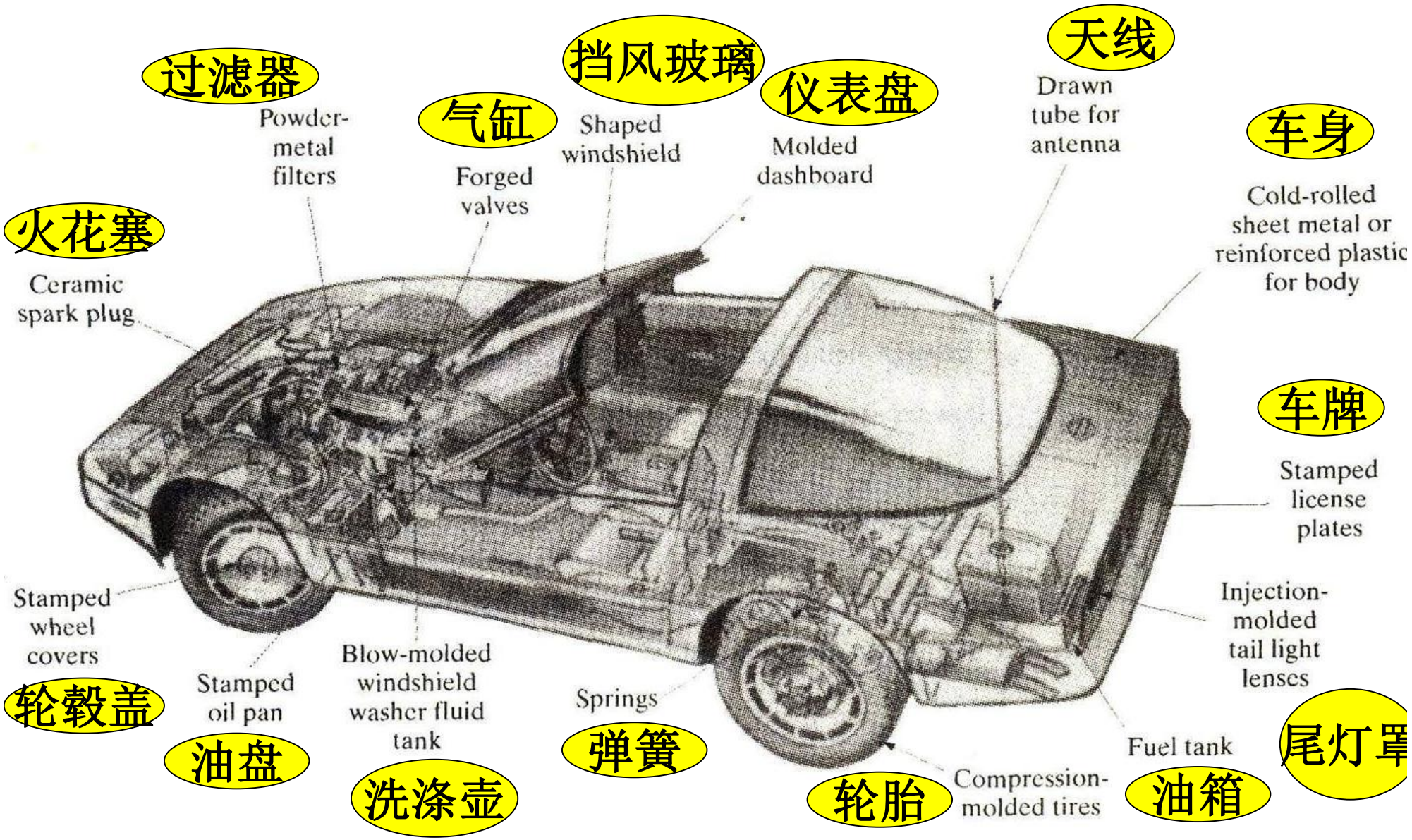



**Figure III.1 Formed and shaped parts in a typical automobile**

**Some products consist of a few parts :**

- **stapler（*订书机*）**
- **pipe wrench（*管钳*）**
- **light fixture（*灯具*）**

**Some products consist of thousands or even millions of parts :**

- **automobiles**
- **computers**
- **airplanes**
- **ships**



**TABLE 1.1**

| Approximate Number of Parts in Products | |
|---|---|
| Common pencil | 4 |
| Rotary lawn mower（旋转式除草机） | 300 |
| Grand piano | 12,000 |
| Automobile | 15,000 |
| Boeing 747–400 | 6,000,000 |

**Some products are thin :**

- **aluminum foil（*铝箔*）**
- **plastic film（*塑料薄膜*）**
- **electrical-resistance wire（*电阻丝*） for toasters（*吐司炉*）**


**Some products are thick :**

- **ship hulls（*船体*）**
- **boiler plates（*锅炉板*）**
- **machine bases**

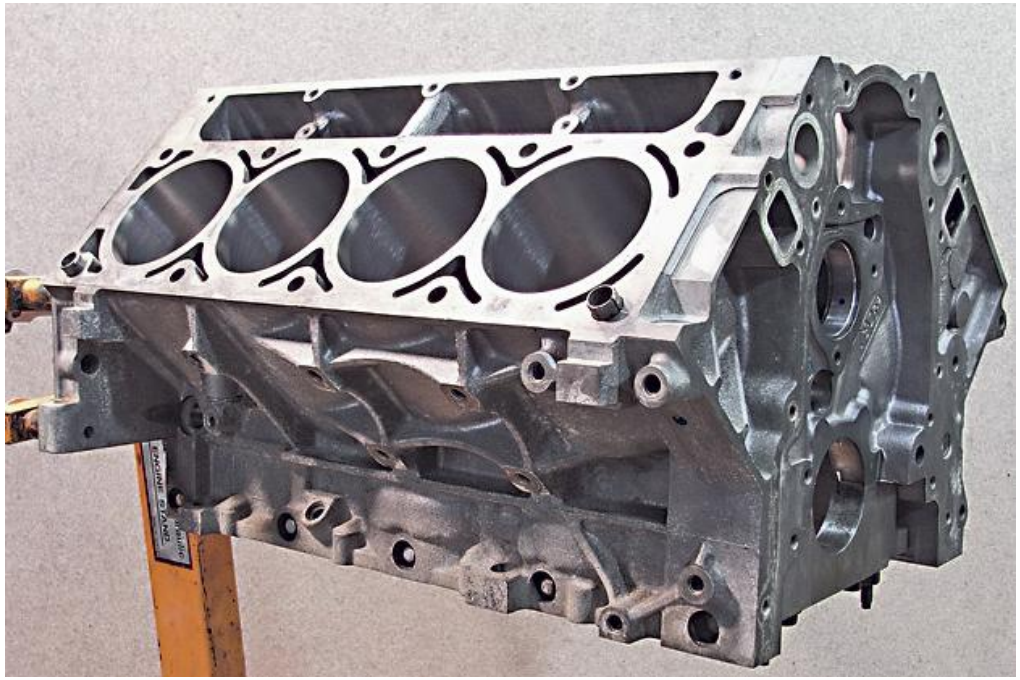
**Some products have simple shapes with smooth curvatures（*曲率/弧线*）：**

- **bicycle handles（*把手/手柄*）**
- **ball bearings（*滚珠轴承*）**
- **cooking pots**


**others have complex configurations（*结构/外形*） and detailed surface features :**

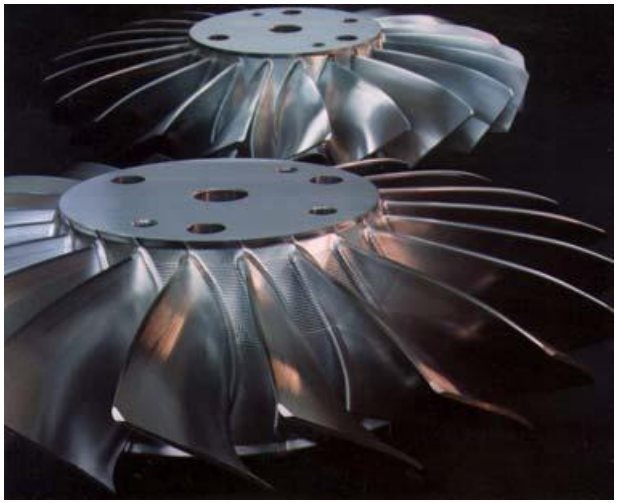
- **coins（*硬币*）**
- **silverware（*银器*）**
- **engine blocks（*发动机缸体*）**

Obverse Reverse



**Some products are used in critical applications :**

- **turbine blades（*涡轮叶片*）**
- **connecting rods（*连杆*） for engines**
- **elevator cables（*电梯吊索*）**

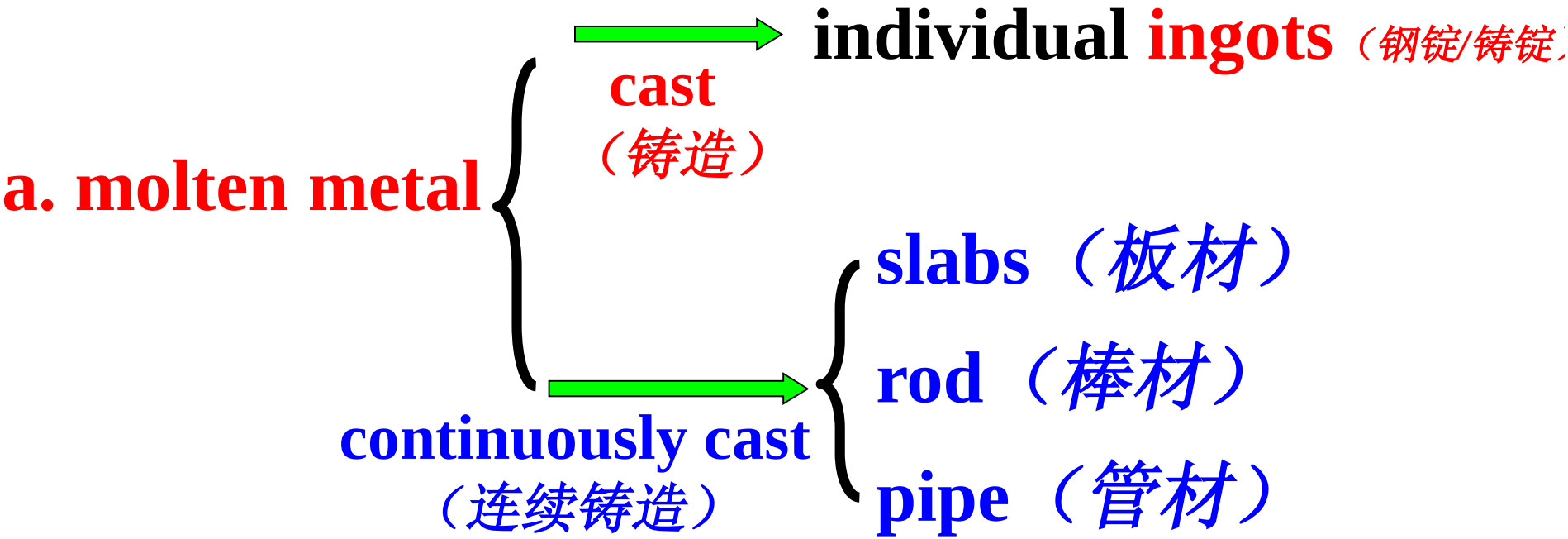


**Others are used in routine applications（*日常应用*）：**

- **watering cans（*喷壶*）**
- **spoons（*匙羹*）**
- **paper clips（*回形针*）**

# Initial Material
# *(原材料）*

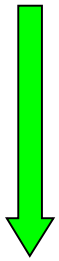
- **For metals：**



**rolling（*轧制*）/forging（*锻造*）/extrusion & drawing（*挤压与拉拔*）/sheet-metal forming（*金属板材成形*）**
**Chapter 4/5/6/7**

- **Then, formed by the deformation processes（*变形工艺*） described in Part II：**

**cast structures（*铸造组织/结构*）**



**converted into**

**wrought (“worked”) structures**
**（*锻造组织/结构*）**

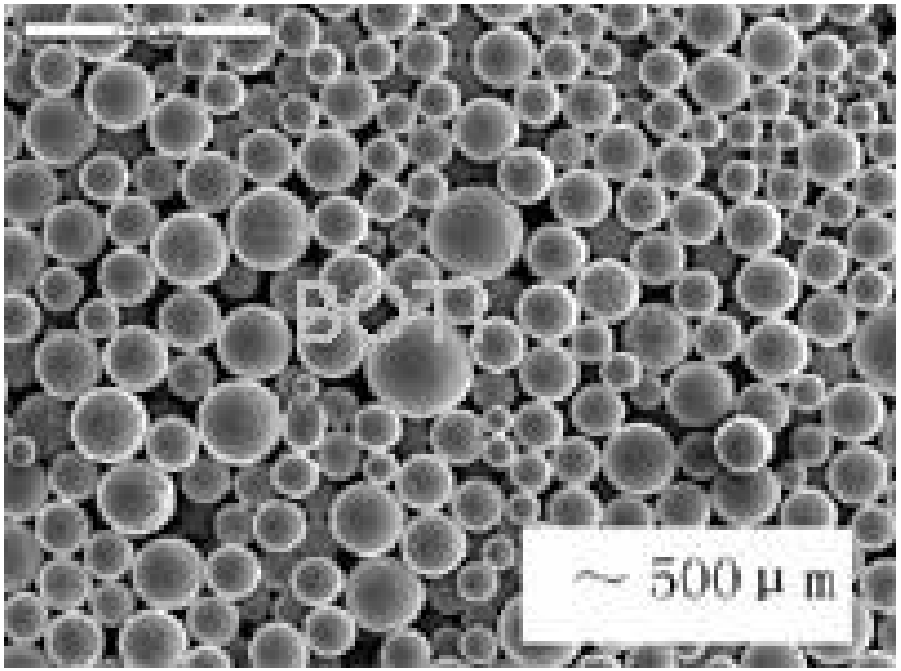
- **For metals：**

**powder metallurgy （*粉末冶金*）**
~~**(Chapter 8)**~~

**shaping**

**b. metal powders** → **parts**

**（*金属粉末*）**




## For plastics（塑料）:

Chapter 18 in the 4th version of the textbook

– pellets（颗粒）

– flakes （片）

– powder （粉末）

shaping

forming

individual parts

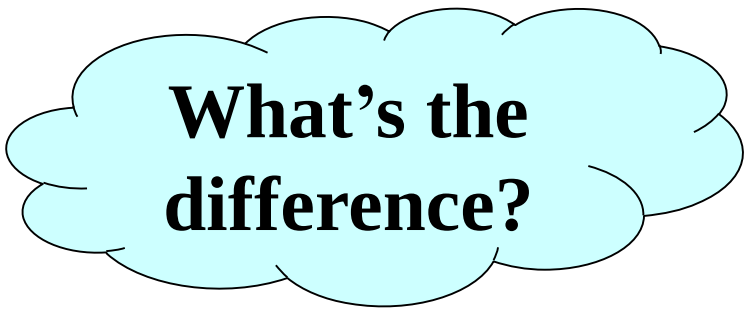
or

continuous products

（连续型材）

**Forming Process（*成形工艺*）**

**Shaping Process（*成型工艺*）**



# Forming（成形）

**plastic forming/deformation**
**（塑性成形/变形;塑性加工）**

**elastic deformation**
**（弹性变形）**

- **Changing the shape of an existing solid body（实体）**

**all called**

**workpiece, stock, or blank**
**（毛坯/坯料/工件）**

**in the shape of a plate（板材）, a sheet（板料）, a bar（杆件）, a rod（棒材）, wire（线材）, or tubing（管件/管材）**

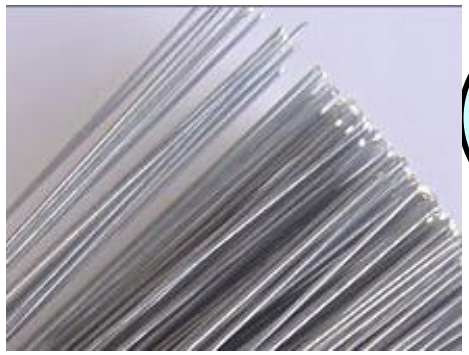
# Examples of *forming*:

**drawn wire**
***(拉拔线材）***

**cut**

**straight piece**

**forming**
***（成形/变形）***



**blank**
***（毛坯）***

**bending** and **twisting**
***（弯曲和扭转）***

**wire coat hanger**

**part**

# Examples of *forming*:

**rolled sheet**
**（*轧板*）**

↓ **blanking（*落料*）**

**flat piece with suitable size**

**forming**

↓ **stamping（*冲压*）**

**metal body for an automobile**

**strip（*带料/条料*）in coils（*卷料/卷材*）**

**blank**


**part/product**

# Examples of *forming*:

**extrusion sheet**
**（*挤塑片材*）**

**cut**

**flat piece with suitable size**

**blank**
**（*毛坯*）**

**vacuum thermoforming**
**（*真空热成形/吸塑*）**

**part**

**food container**

# Shaping（*成型*）

- **Involves molding（*模塑成型*） and casting.**
  - **the resulting product is usually at or near the final desired shape;**
  - **may require little or no further finishing.**

# Examples of shaping:

plastic pellets

raw material

forcing molten plastic into a mold（模具） in the shape of the hanger

injection molding
（注射/注塑成型）

shaping
（成型）

plastic coat hanger

part

# Examples of shaping plastics:

– telephone receivers

– refrigerator-door liners（*冰箱门内衬*）

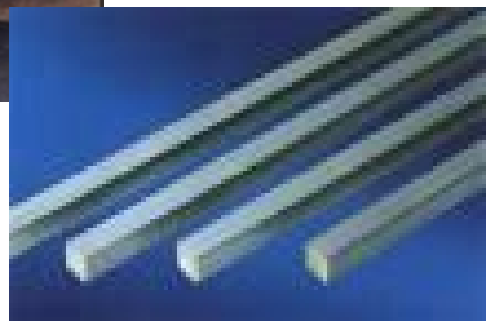
– keys for keyboards

– toys


- **Some manufacturing operations**
  - **– rolling（*轧制*）**
  - **– extrusion（*挤压/挤出*）**
  - **– drawing（*拉拔*）**

**produce**

- **Long continuous products（*连续型材*）**
  - **– plates**
  - **– sheets**
  - **– tubing**
  - **– bars with various cross-sections（*横截面*）**



- **materials**
  - **– metallic materials （*金属材料*）**
  - **– nonmetallic materials（*非金属材料*）**
  - **– reinforced plastics（*增强塑料*）**

- **then cut into the desired lengths.**

- **Other operations**
  - **forging（锻造）**
  - **powder metallurgy（粉末冶金）**
  - **sheet-metal forming（钣金成形）**
  - **most forming and shaping processes for nonmetallic materials**

produce

- **discrete（离散的/独立的）products：**
  - **turbine disks（涡轮盘）**
  - **gears（齿轮）**
  - **bolts（螺栓）**
  - **sheet-metal parts（钣金件）**
  - **plastics parts（塑件）**

## TABLE III.1 General Characteristics of Forming and Shaping Processes

| Process | Characteristics |
|---|---|
| Rolling | |
| Flat | Production of flat plate, sheet, and foil in long lengths, at high speeds, and with good surface finish, especially in cold rolling; requires high capital investment; low to moderate labor cost. |
| Shape | Production of various structural shapes, such as I-beams, at high speeds; includes thread rolling; requires shaped rolls and expensive equipment; low to moderate labor cost; moderate operator skill. |
| Forging | Production of discrete parts with a set of dies; some finishing operations usually required; similar parts can be made by casting and powder-metallurgy techniques; usually performed at elevated temperatures; die and equipment costs are high; moderate to high labor cost; moderate to high operator skill. |
| Extrusion | Production of long lengths of solid or hollow products with constant cross-section; usually performed at elevated temperatures; product is then cut into desired lengths; can be competitive with roll forming; cold extrusion has similarities to forging and is used to make discrete products; moderate to high die and equipment cost; low to moderate labor cost; low to moderate operator skill. |
| Drawing | Production of long rod and wire, with round or various cross-sections; smaller cross-sections than extrusions; good surface finish; low to moderate die, |

| | |
|---|---|
| Drawing | Production of long rod and wire, with round or various cross-sections; smaller cross-sections than extrusions; good surface finish; low to moderate die, equipment, and labor costs; low to moderate operator skill. |
| Sheet-metal forming | Production of a wide variety of shapes with thin walls and simple or complex geometries; generally low to moderate die, equipment, and labor costs; low to moderate operator skill. |
| Powder metallurgy | Production of simple or complex shapes by compacting and sintering metal powders; can be competitive with casting, forging, and machining processes; moderate die and equipment cost; low labor cost and skill. |
| Processing of plastics and composite materials | Production of a variety of continuous or discrete products by extrusion, molding, casting, and fabricating processes; can be competitive with sheet-metal parts; moderate die and equipment costs; high operator skill in processing of composite materials. |
| Forming and shaping of ceramics | Production of discrete ceramic products by a variety of shaping, drying, and firing processes; low to moderate die and equipment cost; moderate to high operator skill. |

# Main Content in Part II

- **The important factors involved in each forming and shaping process**
- **Materials and process variables（工艺变量/工艺参数）**
- **Characteristics of the machinery and the equipment**

**significantly affect：**
- **quality of the product**
- **rate of production**
- **economics of the manufacturing operation**


**Part II also describes:**

Chapter 18

**ø Processing of polymers（*聚合物*）;**

**ø Rapid prototyping operations（*RP/快速原型技术*）.**

~~Chapter 9~~

**3DP**
**（3 Dimensional Printing）**
***（3D打印）***

# KEY TERMS

- **forming** 成形，变形
- **shaping** 成型
- **compressive** 压缩的，受压的
- **tensile** 拉伸的，受拉的
- **workpiece** 工件
- **stock** 坯料
- **blank** 毛坯
- **bulk deformation processes** 体积变形工艺
- **sheet-forming processes** 金属板料成形工艺
- **workability** 可加工性
- **formability** 可成形性

# Review Questions

1. **What's the difference between forming processes and shaping processes？ Give some examples respectively.**
2. **What's the difference between long continuous products and discrete products？ Give some examples respectively.**