

一、 Fill in the blanks (1'×10 = 10')

1. The advantage of microwave heating is that it is extremely _____ .
2. The mechanical properties of ceramics are good in _____, The greatest weakness is _____.
3. Ferrous Alloys normally contains major phases, called austenite, _____, _____, martensitic.
4. The components as well as the interface between them can usually be _____ identified.
5. Surface treatment of reinforcing materials is done to _____ the adhesion of fillers and fibers to matrix resin by _____ the surface of the solid.
6. The properties of materials are defined by the nature of their chemical bonds, their _____ ordering and their _____.

二、 True or false (indicate with “√” or “×”, 1'×10 = 10')

1. All amorphous materials are glasses.
2. Aluminum alloys offer superior specific strength in high temperatures.
3. The properties of crystals are different in various crystallographic directions.
4. Titanium alloys have lower density and high strength.
5. Most of life and industrial glass are made from silica and silicate glasses.
6. Magnesium is the lightest of all structural metals.
7. Glasses is made from elements, simple chemical compounds, complex organic molecules, salt mixtures and alloys.
8. Glass when newly formed, with a perfect surface, is very strong about five times as strong as steel.
9. MMC、PMC、CMC are all composite, and matrix are metal, ceramic and organic polymer.
10. 玻璃化温度和熔点是表征聚合物热性能的重要指标。 .

三、 Choose the right answer (1'×10 = 10')

1. Which of the following descriptions would not be applicable to ceramics?
a. Mixed ionic and covalent bonding b. Brittle c. Hard d. Ductile
2. 组成铸铁的基本元素是_____.
a. O; b. C; c. S; d. Si; e. Fe; f. Al; g. P
3. 低合金钢合金元素含量_____, 而高合金钢_____.
a. <2%; b. <5%; c. >10%; d. >13%
4. Hardened concrete should be durable, strong, watertight and resistant to abrasion. All of these properties are influenced by the _____ of the Portland cement paste.
a. quantity b. weight percent c. quality d. density
5. The major phases in Portland cement are: _____, _____, _____ and ferrite.
a. alite b. limestone c. aluminate d. belite e. silica f. calcium sulfate g. ferrite

四、 Terms and definitions (4'×5 = 20')

1. Composite 2. Fatigue limit 3. Brass 4. Physical properties 5. Workability

五、Questions and replies (8'×4 = 32')

1. 指出原子键的四种类型；简述各性能特点；为各键型举例一种材料。
2. What are the differences between ceramics and glass in structure, properties and manufacturing methods?

Answer:

3. What are the main mechanical properties of a material investigated with the tensile test?
4. Please list the three reactions during the addition polymerization process and explain how the process is terminated.

六、Read and discuss (9'×2 = 18')

1. Concrete has several unusual characteristics that make it the most versatile and widely used of all construction materials. Freshly mixed concrete is a combination of aggregates (inert materials) and a paste composed of Portland cement and water. The aggregates generally used are sand and gravel or crushed stone. These aggregates have no cementing value of their own; their function in concrete is to serve as a filler. The cement-water paste changes from a semifluid substance into a solid binder as a result of chemical reactions between the water and the various compounds in the cement. The final quality of the concrete depends upon the effectiveness of the hardened paste in binding the aggregate particles together and in filling the voids between the particles.

Questions:

- (1) How many types of raw materials involving in concrete production? And what are their functions, respectively?
- (2) Analyze the major factors affecting concrete quality.

2. Several stress-strain plots are shown in Figure 1. One of the lines shows the character of fiber.

Questions:

Point out the polymeric materials of the other three lines. How to classify plastics? Please give some examples for different properties of plastics.

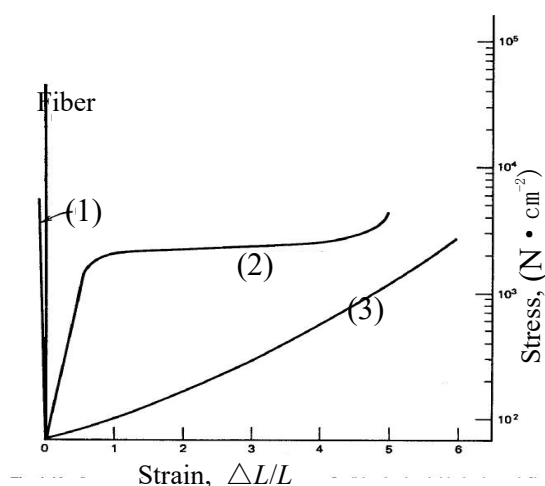


Fig. 1: Stress-strain plots

参考答案

一、 Fill in the blanks (1'×10 = 10')

1. The advantage of microwave heating is that it is extremely rapid .
2. The mechanical properties of ceramics are good in compression , The greatest weakness is brittleness .
3. Ferrous Alloys normally contains major phases, called austenite, cementite, graphite, martensitic.
4. The components as well as the interface between them can usually be physically identified.
5. Surface treatment of reinforcing materials is done to improve the adhesion of fillers and fibers to matrix resin by modifying the surface of the solid.
6. The properties of materials are defined by the nature of their chemical bonds, their atomic ordering and their microstructure.

二、 True or false (indicate with “√” or “×”, 1'×10 = 10')

1. (×) All amorphous materials are glasses.
2. (×) Aluminum alloys offer superior specific strength in high temperatures.
3. (√) The properties of crystals are different in various crystallographic directions.
4. (√) Titanium alloys have lower density and high strength.
5. (√) Most of life and industrial glass are made from silica and silicate glasses.
6. (√) Magnesium is the lightest of all structural metals.
7. (√) Glasses is made from elements, simple chemical compounds, complex organic molecules, salt mixtures and alloys.
8. (√) Glass when newly formed, with a perfect surface, is very strong about five times as strong as steel.
9. (×) MMC、PMC、CMC are all composite, and matrix are metal, ceramic and organic polymer.
10. (√) 玻璃化温度和熔点是表征聚合物热性能的重要指标。 .

三、 Choose the right answer (1'×10 = 10')

1. Which of the following descriptions would not be applicable to ceramics? (d)
a. Mixed ionic and covalent bonding b. Brittle c. Hard d. Ductile
2. 组成铸铁的基本元素是_____ (b, d, e)
a. O; b. C; c. S; d. Si; e. Fe; f. Al; g. P
3. 低合金钢合金元素含量_____, 而高合金钢_____。 (b, c)
a. <2%; b. <5%; c. >10%; d. >13%
4. Hardened concrete should be durable, strong, watertight and resistant to abrasion. All of these properties are influenced by the _____ of the Portland cement paste. (c)
a. quantity b. weight percent c. quality d. density
5. The major phases in Portland cement are: _____, _____, _____ and ferrite. (a, c, d)
a. alite b. limestone c. aluminate d. belite e. silica f. calcium sulfate g. ferrite

四、 Terms and definitions (4'×5 = 20')

1. Composite: A composite is a combined materials created by the synthetic assembly of two or more components a selected filler or reinforcing agent and a compatible matrix binder in order to obtain specific characteristics and properties.
2. Fatigue limit: The maximum load in pounds per square inch that can be applied an infinite number of times without causing failure.

3. Brass: An alloy of copper and zinc.
4. Physical properties: The behavior of materials subjected to the action of temperature, electric or magnetic fields or light.
5. Workability: The ease with which concrete is placed and consolidated.

五、Questions and replies (8'×4 = 32')

1. Answers: ①离子键(1'): 结合力很大, 离子晶体的硬度高, 强度大, 热膨胀系数小, 脆性大。例: 陶瓷材料(1')。②共价键(1'): 结合力很大, 共价晶体的硬度高、强度高、脆性大、熔点高、沸点高和挥发性低。例: 陶瓷材料(1')。③金属键 (1'): 良好的导电性和导热性, 正的电阻温度系数, 不透明并呈现特有的金属光泽, 良好的塑性变形能力, 强韧性好。例: 金属材料(1')。④范特瓦尔斯力(1'): 很弱, 分子键结合的固体材料熔点低、硬度也很低, 无自由电子, 良好的绝缘性。例: 聚合物材料(1')。
2. Answers: 1) 结构: 陶瓷: 晶体材料; 玻璃: 非晶态。(2') 2) 性质: 陶瓷: 不透明, 耐高温, 具有固定的熔点, 各相异性; (2'); 玻璃: 透明, 不耐高温, 不具有固定的熔点, 各相同性。(2') 3) 制备方法: 陶瓷: 先成型, 再烧结; 缓慢冷却以利于晶体形成; 玻璃: 熔融后成型, 淬冷法。(2')。
3. Answers: they are the ductility [1'], tensile strength [1'], proportional limit [1'], elastic limit [1'], modulus of elasticity [1'], resilience [1'], yield point, yield strength [1'], ultimate strength and breaking strength [1'].
4. Answers: The three significant reactions that take place in addition polymerization are: initiation (2'), propagation (2') and termination (2'). Termination typically occurs in two ways: combination and disproportionate (2').

六、Read and discuss (9'×2 = 18')

1. Answers:
 - (1) Types of raw materials: Portland cement paste, water, sand and gravel (3').
Functions: aggregates serve as a filler; the cement-water paste changes from a semifluid substance into a solid binder(3').
 - (2) The final quality of the concrete depends upon the effectiveness of the hardened paste in binding the aggregate particles together and in filling the voids between the particles (3').
2. Answers:
 - i. The other lines are: (1) Rigid plastic [1']; (2) Flexible plastic [1']; (3) Elastomer [1'].
 - ii. There are two types of plastics—flexible plastics and rigid plastics [2'].
 - iii. Flexible plastics: possess moderate to high degrees of crystallinity and a wide range of T_m and T_g values. They have moderate to high tensile strengths, and ultimate elongation [2'].
 - iv. Rigid plastics: have high moduli and moderate to high tensile strengths, they undergo very small elongations before rupturing [2'].