UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2009/2010

November 2009

EBB 524/3 – Composite Materials

Duration : 3 hours

Please ensure that this examination paper contains FIVE printed pages before you begin the examination.

This paper consists of SEVEN questions.

Instruction: Answer **FIVE** questions. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.

The answers to all questions must start on a new page.

All questions must be answered in English.

1. [a] What are the **advantages** and disadvantages of using glass fiber, carbon fiber and aramid fiber to reinforced polymer composites?

(40 marks)

[b] Discuss the differences between:

(i) hybrid composites and laminar composites.

(ii) particle reinforced composites and fiber reinforced composites.

(30 marks)

[c] By using suitable diagrams, draw different **type of patterns** of fiber reinforcement in polymer composites.

(30 marks)

2. [a] Discuss briefly the following forming processes for polymer composites:

(i) pultrusion.

(ii) filament winding.

(iii) reinforced reaction injection moulding (RIM).

(25 marks)

[b] What are the differences between “Biodegradable Polymer Composites” and “Non-Biodegradable Polymer Composites”?

(25 marks)

[c] In a unidirectional carbon fibre/epoxy composites, the modular ratio is 40 and the fibers take up 50% of the cross-section. What percentage of the applied force is taken by the fibers?

(50 marks)

3. [a] Assuming that you are planning to develop a metal matrix composite reinforced with in-situ particulate through a powder metallurgy route. Based on a specific metal matrix system, outlined the fabrication steps involve to fabricate the composite. Explain how the processing condition/parameter would influence the physical and mechanical properties of the composite.

(60 marks)

[b] Write down the 'law of mixtures' equation in terms of the properties and quantities of reinforcement and matrix. Define all the terms involved. What are the importances of this law? Comment on its experimental validity.

(40 marks)

4. [a] For a material that are used for heavy duty electrical contacts such as metal matrix composite with particles of tungsten or molybdenum in silver and copper matrices, what are the requirement for this material? What are the roles of the matrix and the reinforcement components?

(40 marks)

[b] In designing metal matrix composite, what are the issues that need to be considered when selecting either continuous fibre or particulate reinforcement?

(60 marks)

5. [a] What is ceramic? In term of processing, give a significant different between ceramic, glass and glass ceramic.

(40 marks)

[b] With the aid of appropriate diagrams, describe on the processing of CMC's using following methods:

(i) Reaction Bonding.

(ii) Slurry infiltration.

(iii) Lanxide Process.

(60 marks)

6. Ceramic Matrix Composite is an approach to improve the toughness of ceramic materials. Differentiate toughening mechanisms for fibre and particulate reinforcement.

(100 marks)

7. [a] What are the advantages and disadvantages of Polymer Nanocomposites over Polymer Microcomposites?

(30 marks)

[b] A metal matrix composite is made from a boron (B) fiber reinforced aluminum alloy (Figure 1). To form the boron fiber, a tungsten (W) wire (r = 20μm) is coated with boron, giving a final radius of 100 μm. The aluminum alloy is then bonded a round the boron fiber, giving a volume fraction of 0.80 for the aluminum alloy. Assuming that rule of mixture is applied also to ternary mixture; calculate the effective tensile elastic modulus of the composite material under isostrain conditions. Data E_w = 410GPa; E_B= 379GPa; E_{Al} = 68.9GPa.

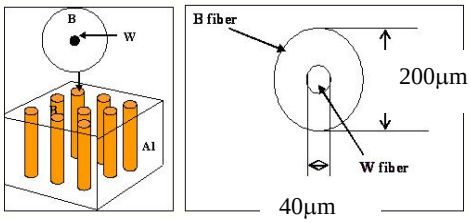

Figure 1

(30 marks)

[c] Sketch and briefly describe a stress-strain curve for fibre reinforced Ceramic Matrix Composite which subjected to tension and flexural force.

(40 marks)

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