UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2010/2011

November 2010

EBB 526/3 - Electronic Packaging

Duration : 3 hours

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

This paper consists of SIX 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] A typical formulation of capillary underfill (CUF) is shown in Table 1.

Table 1: Typical formulation of capillary underfill.

Ingredients	**%**
Epoxy resin	40
Hardener	10
Filler (SiO_2)	45
Catalyst	2
Surfactant	2
Defoamer	0.5
Colour	0.5

(i) What is underfill?

(5 marks)

(ii) Describe the function of each of the ingredients.

(10 marks)

(iii) What is the effect to the curing process and degree of crosslinking if catalyst is not used?

(10 marks)

(iv) What is the effect to the underfill if curing agent is not used?

(5 marks)

(v) Can you predict the outcome if 20% of curing agent is used?

(5 marks)

(vi) If we do not want to use defoamer, can you propose an alternative method to remove the buble?

(5 marks)

(vii) If we do not want to use SiO_2 what would you recommend as an alternative filler and why?

(10 marks)

[b] Can you elaborate on why we need to use thermal interface material (TIM) in flip chip package? Select four (4) examples of TIM and justification of good TIM properties.

(20 marks)

[c] (i) Describe what is Moore's Law and its impact to electronic industry.

(10 marks)

(ii) High filler content capillary underfills (CUF) usually will have high modulus and therefore low coefficient of thermal expansion (CTE). In your opinion, why we need to optimized filler content in CUF?

(20 marks)

2. [a] A ball grid array (BGA) package with a face area of 4 cm^2, mounted on a PWB, dissipates 0.5W of heat. Calculate the BGA surface temperature assuming that the package loses heat by natural convection and radiation and no heat flows into the printed wiring board (PWB). Assume that the package surface emissivity is 0.9 and that the ambient temperature is 25^oC. Refer Figure 1.

Data:

h_{nc}, natural convection heat transfer coefficient = 10 W/m^2K

σ, Boltzman constant = 5.67 x 10^{-8} W/m^2K^4

Figure 1

(60 marks)

[b] Heat is an unavoidableby-product of every electronic device and circuit and is usually detrimental to performance and reliability. Hence thermal management is one of the important tasks of packaging engineer. There are three fundamental factors which must be considered in thermal management. What are they and describe each of them.

(40 marks)

3. [a] Discuss the differences between electronic packages based on wire-bonding technology and flip-chip technology. Explain the functions of each materials being used in those packages.

(70 marks)

[b] Discuss the purpose of an electronic package.

(30 marks)

4. [a] Draw a curve for a typical product reliability failure pattern.

(20 marks)

[b] Outline and describe the use conditions for personal computer with referring to a product life cycle.

(20 marks)

[c] Explain why reliability of a product is extremely important to a company by giving three reasons. Consequently, explain the differences between the standard based and knowledge based approaches in designing product reliability as illustrated in Figure 2. From the figure, explain what is meant by the safety factors, apparent reliability and expected reliability and describe how those factors can be used to estimate the warranty period of the product.

Figure 2 - A diagram showing the differences between standard based and knowledge based approaches in designing product reliability

(60 marks)

5. [a] During the open short test done by the substrate manufacturer, an abnormally high shorts defect was observed. Upon further investigation by the supplier, the defect tends to occur at one particular location within a unit and at one particular unit within the panel. The illustration of the defect looks as in Figure 3.

(i) Which process step is the most probable location where such defect can occur?

(ii) Please give an explanation on how such defect can occur?

(iii) How to prevent the **occurrence** of the defect?

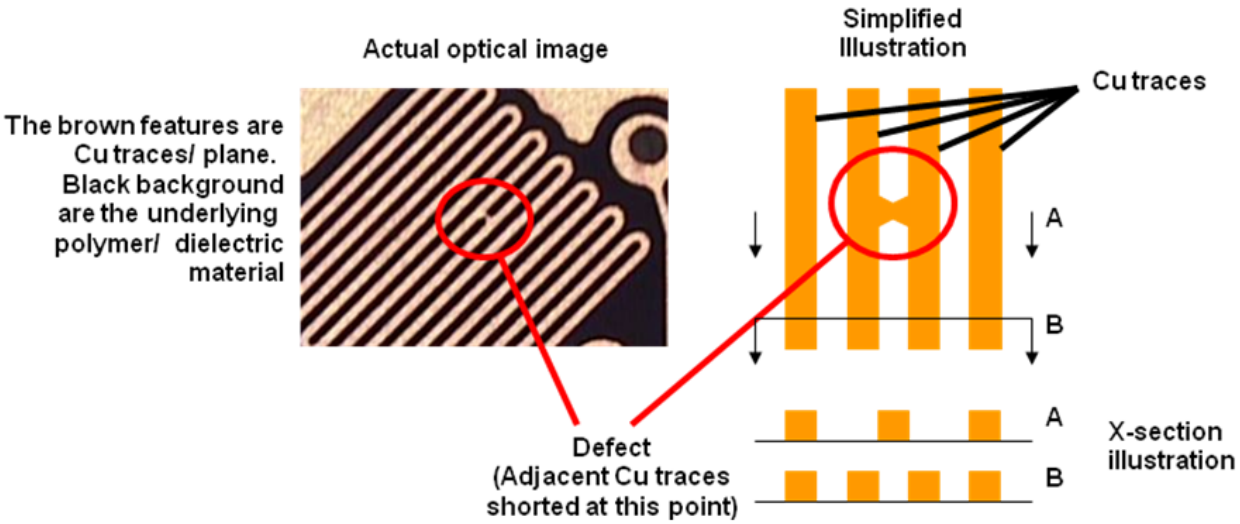

Figure 3

(60 marks)

[b] With aid of sketches, describe the location of core in substrate materials. What are the desire quality characteristics for core materials? State also reasons for each characteristic and how to achieve the characteristics.

(40 marks)

6. [a] Reliability of solder joints rely on a number of factors, among others; wettability, IMC formed, strength and fatigue properties.

Assess the importance of the above mentioned factors to reliability. Provide example and illustrations (whenever necessary) to explain your points.

(70 marks)

[b] Discuss in brief the importance of thermal ageing in evaluating reliability of solder joint.

(30 marks)

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