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MAE 438/538 Smart Materials
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Test No. 2
Closed Book

This test consists of 25 problems on 2 pages. Answer all questions in the blue book provided.

1. What are the main requirements for the properties of materials used for thermoelectric energy generation?

2. By using a sketch, describe the principle behind the construction of a thermoelectric energy generator.

3. Describe the Peltier effect.

4. Describe the principle involved in attaining temperature-sensing ability using an appropriately designed carbon fiber polymer-matrix composite in which all the fibers are of the same type.

5. Describe the principle behind the use of the interlaminar interface of an appropriately designed carbon fiber polymer-matrix composite for sensing temperature.

6. Describe the two main mechanisms of EMI shielding.

7. Why is flexible graphite effective as an EMI gasket material?

8. Why is flexible graphite attractive as a heating element for the deicing of aircraft composites?

9. Why is a metal not attractive as a heating element for the deicing of aircraft composites?

10. Describe a main advantage and a main disadvantage for using a polymer instead of a ceramic as a dielectric material in electronic packaging.

11. Why is there a need in electronic packaging for ceramics that can be sintered at 1000ºC or below?

12. What are the main requirements for the properties of an encapsulation material in electronic packaging?

13. What are the main requirements for the properties of a thermal interface material in electronic packaging?

14. What are the main disadvantages of copper as a heat sink material?

15. Describe a main advantage and a main disadvantage of a leadless chip carrier compared to a chip carrier with leads.

16. What are the main ingredients in an electrically conductive thick-film paste?

17. What are the main criteria that govern the choice of discontinuous fillers for polymer-matrix composites that are used for EMI shielding?

18. Why does the addition of discontinuous ceramic fibers to a ceramic improve the toughness of the ceramic?

19. What are the main requirements for the properties of a material for low observability?

20. Name the main advantages of a metal-matrix composite compared to a polymer-matrix composite.

21. Describe a method of making carbon-carbon composites.

22. Describe a method for improving the oxidation resistance of a carbon-carbon composite.

23. Describe the main disadvantages of powder metallurgy compared to liquid metal infiltration for making metal-matrix composites.

24. Why does the addition of latex to cement improve the thermal insulation and heat retention abilities of cement?

25. Why should the volume fraction of discontinuous fibers in a cement-matrix composite be kept low?