

Uva Wellassa University, Sri Lanka
End Semester Examination – July 2010



CHE 455-2 Ceramic Technology -Repeat-
Time: Two (02) hours

Total 05 Questions

Answer four (04) questions only

- 1). i. Among CaF_2 , SiO_2 and SiC ceramics, which should show the highest degree of the ionic character? Briefly explain your answer.
- ii. Show that the minimum cation-to-anion radius ratio for a coordination number of 3 is 0.155.
- iii. The ionic radii of K^+ and O^{2-} are 0.138 and 0.140 nm, respectively. What would be the coordination number for each O^{2-} ion?
- iv. Calculate the theoretical density of NiO having the rock salt crystal structure. Note that ionic radii of Ni^{2+} and O^{2-} are 0.069 nm and 0.140 nm, respectively. Atomic weights of Ni and O are 58.69 amu and 16.00 amu, respectively.
- v. What is the basic building block of silicate ceramics? Make a rough sketch of this building block.
- (25 marks)
- 2). i. What is *fracture toughness*? Why is the measured fracture toughness of ceramic materials a considerably lower than that predicted by theory?
- ii. Briefly explain why ceramics show a considerable variation and scatter in the fracture toughness.
- iii. List two main difficulties encountered in performing tensile tests to ascertain stress-strain behavior of brittle ceramics.
- iv. Make a rough sketch of four point loading scheme that can be used to measure the flexural strength of ceramics.
- v. An alumina rod with a circular cross section is loaded using a three-point bending mode. Compute the minimum possible radius of the rod without fracture, given that the applied load is 5×10^3 N, flexural strength is 2×10^6 Pa and the separation between load points is 5×10^{-3} m.
- (25 marks)

- 3).
- i. Name three polymorphic forms of carbon.
 - ii. Non-crystalline ceramics has no regular crystalline structure, hence non existence of dislocations. If so, what is the main mechanism responsible for plastic deformation in non-crystalline ceramics?
 - iii. Typically, ceramic materials maintain very strong bonding between constituent elements. Name three main consequences of this strong bonding on ceramic processing.
 - iv. List three advantages of ceramics over metals for biomedical applications.
 - v. Make a brief comparison between traditional ceramics and advanced ceramics on their *raw materials, processing methods, resultant microstructure and mechanical properties.*

(25 marks)

- 4).
- i. What are the two desirable characteristics of clay minerals for fabrication of ceramics?
 - ii. Briefly explain the main roles of clay, quartz and feldspar in forming whiteware ceramics.
 - iii. With the help of schematic representation, very briefly explain the formation of ceramics by drain casting.
 - iv. List the two main functions of organic binders that are used in powder pressing.
 - v. Some ceramic materials are fabricated by hot-isostatic pressing. Cite the main advantages and limitations associated with this technique.

(25 marks)

- 5.
- i. What is *vitrification*?
 - ii. What are the main factors that determine the *degree of vitrification*?
 - iii. Briefly explain the term *sintering* used in ceramic manufacturing. What is the main driving force for sintering?
 - iv. Give a brief account on the six mechanisms and their paths responsible for transporting matter in sintering, with the help of a schematic representation. Which of these mechanisms are really effective for densification?
 - v. Briefly explain the two major ways used for speeding up sintering.

(25 marks)