ME 216 – Engineering Materials II

Course Information

Mechanical Eng. Dept.
Gaziantep University

Prof. Dr. Ömer EYERCİOĞLU
Prof. Dr. Ali Tolga BOZDANA

ME 216 – ENGINEERING MATERIALS II

COURSE INFORMATION

LECTURERS	TEXT BOOK & REFERENCE BOOKS
Prof.Dr. Ömer EYERCİOĞLU (eyercioglu@gantep.edu.tr) **Prof.Dr. Ali Tolga BOZDANA** (bozdana@gantep.edu.tr)	• **Engineering Metallurgy and Materials (S. SARITAŞ)** • Modern Metallography (R.E. Smallman & K.H.G. Ashbee) • Engineering Metallurgy (R.A. Higgins) • Metals Handbook (ASM International) • Materials Science and Engineering (W.D. Callister)
GRADING	**LABORATORY**
• **Two Midterms (30% each)** • **Final (40%)**	**Metallography Laboratory** (Building of Labs at Mechanical Engineering Dept.)

LECTURE NOTES & ANNOUNCEMENTS

Available at: **https://akbis.gantep.edu.tr/detay/?A_ID=148576**

Syllabus

1. **Introduction:** Metallurgy & Materials Science, Material Selection
2. **Metallurgical Examinations:** Specimen preparation & analyses
3. **Metals & Alloys:** interatomic bonding, structure of crystals, crystal defects, etc.
4. **Phase Diagrams:** Concept & Maps of Equilibrium Phases
5. **Extractive Metallurgy:** Ore-Dressing & Extraction processes
6. **Production of Iron & Steel:** Production of various types of Iron & Steel
7. **Production of Nonferrous Metals:** Production of selected nonferrous materials
8. **Alloy Steels & Cast Irons:** Classification, Properties, Applications
9. **Nonferrous Industrial Alloys:** Classification, Properties, Applications
10. **Deformation of Metals:** Dislocations, Slip systems, Strengthening Mechanisms
11. **Failure & Testing:** Non-Destructive Testing (NDT) methods
12. **Heat Treatment (Part I & II):** Concept & Methods of Heat Treatment Processes
13. **Metalworking & Fabrication:** Metallurgical aspects of material processing

Why do we study materials?

Many scientist or engineer (mechanical, civil, chemical, electrical, etc.) will be exposed to **a design problem involving materials science**. Typical examples could be design of a transmission gear, the superstructure for a building, an oil refinery component, or an integrated circuit chip.

Most of the time, the problem is **to select the right material among many of them**. There are **several criteria** on which the final decision will be made. **The in-service conditions** must be characterized, which dictates **the material properties**. On rare occasions, a material possess the maximum or ideal combination of properties.

Thus, it may be necessary **to trade-off one characteristic for another**. The classic example involves strength and ductility: normally, a material having a high strength will have only a limited ductility. In such cases, **a reasonable compromise** between two or more properties may be necessary.

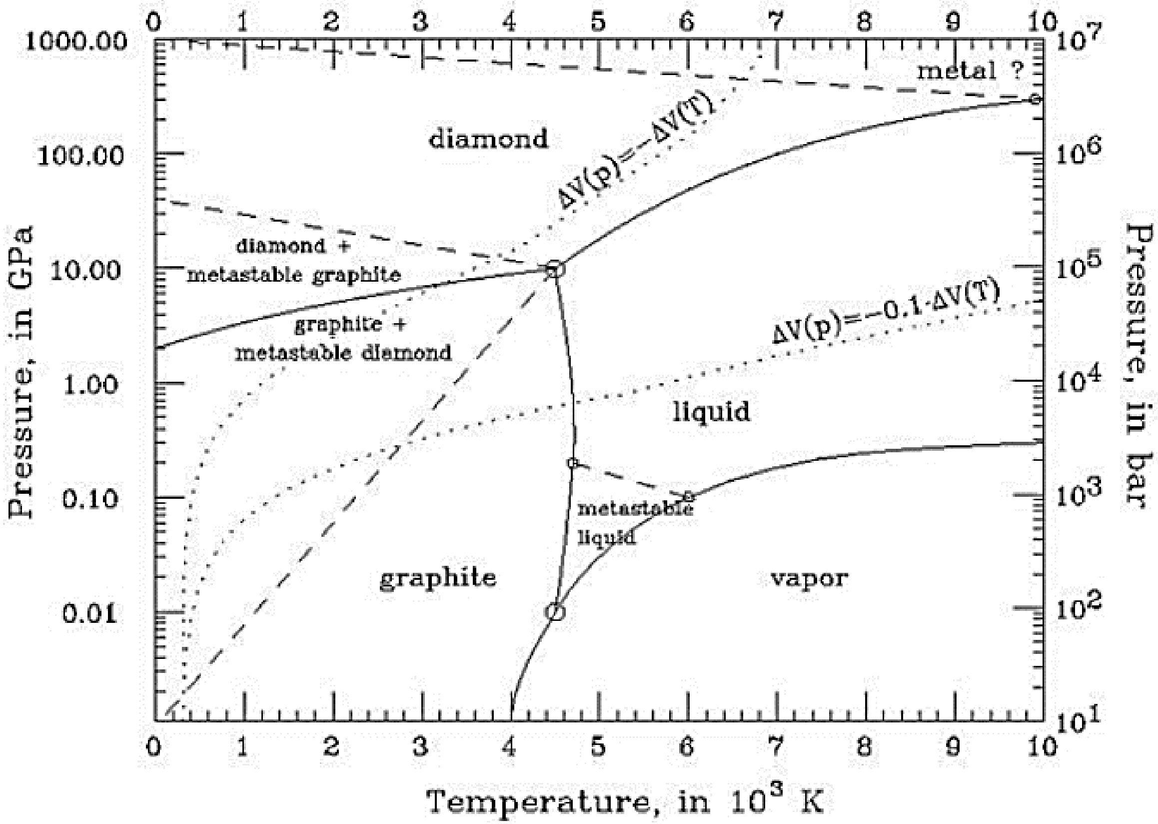
Why do we study materials?

Another consideration in material selection is **deterioration in material properties** that may occur during service operation. For instance, significant reductions in mechanical strength may result from exposure to elevated temperatures or corrosive environments.

Finally, **the overriding consideration is economics**: **What will the finished product cost?** A material may be found that has the ideal set of properties, but is prohibitively expensive. Here again, **some compromise is inevitable.** The cost of a finished piece also includes any expense incurred during fabrication to produce the desired shape.

Thus, an engineer or scientist should be familiar with **the various characteristics** and **structure-property relationships**, as well as **processing techniques of materials**. The more proficient and confident engineer/scientist will be to make judicious materials choices based on these criteria.

Carbon is a very interesting element. Being plentiful (but not in pure form), its occurrence is in the core of stars. Its vitality to life makes it perfect element to **study**, **search** for, **use** in alloys and tissues, **wear** on jewelry, and all.



Phase diagram of carbon (Zazula, 1997)

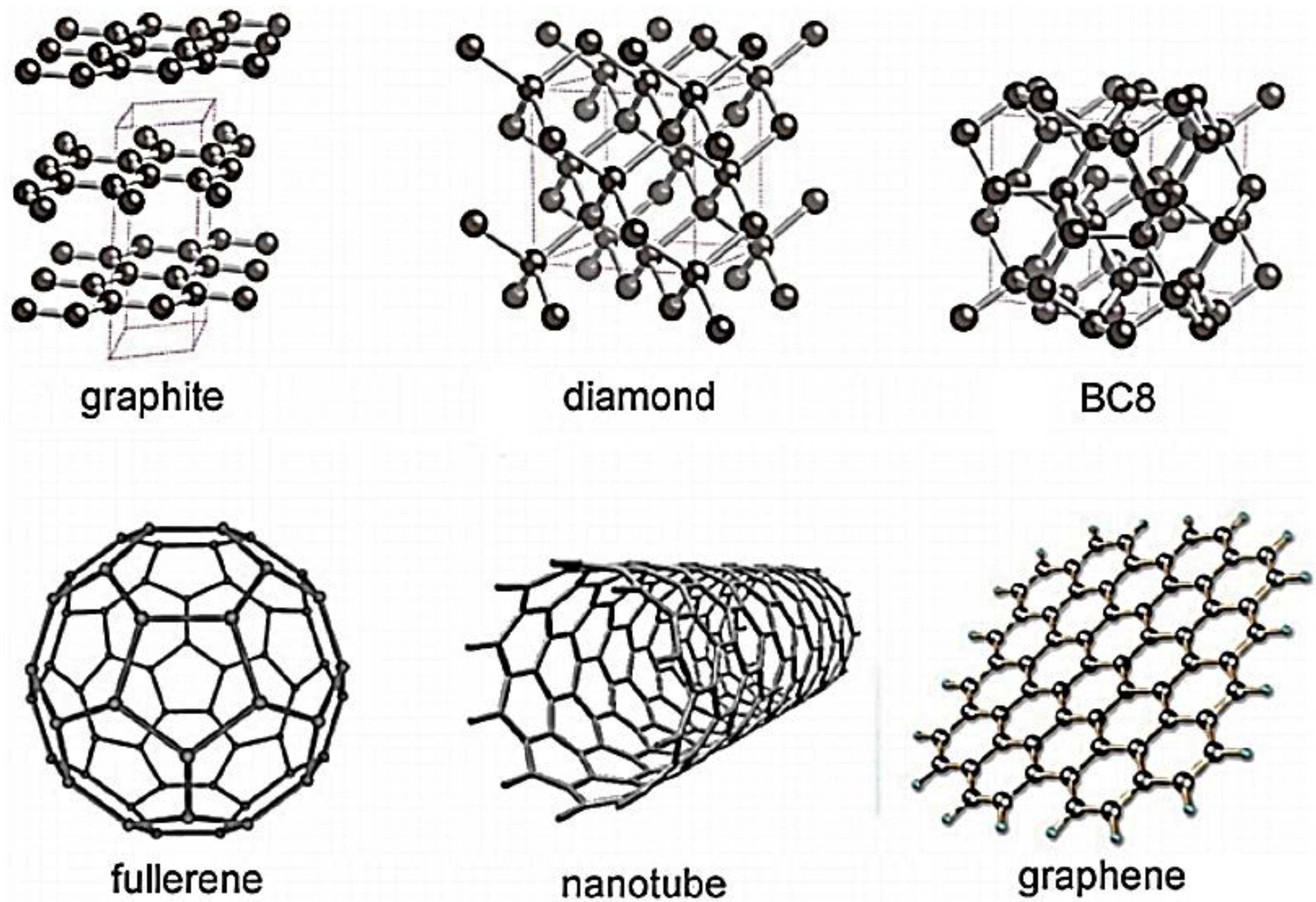
Three allotropes of carbon:

1) **Diamond:** Formed due to **rigid three-dimensional structures of carbon atoms**. Each carbon atom bonded to 4 carbon atoms. The hardest substance on earth.

2) **Graphite:** Formed due to **presence of hexagonal array layers one above another**. Each carbon atom bonded to 3 carbon atoms with 2 single and 1 double bond. Smooth, slippery, and very good conductor of electricity.

3) **Fullerenes (C_{60}):** **Carbon atoms arranged in football-like shape.** Typical uses are conductor, absorbent for gases, lubricant, cosmetics and biomedical applications.

Various Forms of Carbon



Length and Time Scales in Materials Modeling

by Greg Odegard, NASA