Strength of Material and Structure

Special Subjects
Elective 2 credit

HASHIMOTO, Keizo

1. Course Description

This lecture presents the relationships between the mechanical properties of materials and their structures that are utilized in jet engines and airplanes. Strengthening mechanisms of materials are understood systematically, based on the lattice defects such as vacancies, dislocations, stacking faults, grain boundaries, solute atoms, interstitial atoms and precipitates. Fracture and creep behavior and fatigue of metallic materials are also discussed. An overview of the effects of lattice defects on the mechanical properties of materials will be looked at. Observations of fractured specimens using the scanning electron microscope will be trained.

2. Course Objectives

Effects of microstructures on the mechanical properties of materials such as plastic deformation have been discussed. Strengthening mechanism of materials are studied systematically, based on the dislocation theory. The role of lattice defects such as vacancies, dislocations, stacking faults, grain boundaries, solute atoms, interstitial atoms, and precipitates will be discussed in detail using DVD program in University of Pennsylvania. Student will be able to discuss with experts in this field.

3. Grading Policy

submission of assignments(50%) and final report(50%)

4. Textbook and Reference

Textbook
C.J. McMahon Introduction to Engineering Materials (DVD)

University of Pennsylvania
Reference
M. Kato, S. Kumai, S. Onaka Strength of Materials Asakura Publishing Co (1999)ISBN978-4-254-23693-4

5. Requirements(Assignments)

This course is related with the strength and mechanical properties of materials in undergraduate course. Answer the questions in each chapter and report them. Group discussions are recommended.

6. Note

7. Schedule

[1] Materials for jet engine: mechanism and structure
[2] Mechanical Properties 1; Definition of stress and strain
[3] Mechanical Properties 2; Elastic deformation, Hookes law
[4] Mechanical Properties 3; Plastic deformation Yielding and Schmid factor
[5] Mechanical Properties 4; Large scale deformation, necking, fracture
[6] Dislocation and Plastic Deformation 1; Slip
[7] Dislocation and Plastic Deformation 2; Definition of dislocation
[8] Dislocation and Plastic Deformation 3; Observations of dislocation using TEM
[9] Dislocation and Plastic Deformation 4; Plastic deformation of crystal
[10] Dislocation and Plastic Deformation 5; Stress field of screw dislocation
[11] Dislocation and Plastic Deformation 6; Stress field of edge dislocation and Interaction of parallel dislocations, strain energy
[12] Exercise 1; Tensile test of ss400 steel specimen.
[13] Exercise 2; Instruction of scanning electron microscopy (SEM)
[14] Exercise 3; Scanning microscope observations of fracture surface of the tensile tested specimen
[15] Exercise 4; Scanning microscope observations of fracture surface and Discussion