Physical properties of materials

2 units (selection)

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Target⟩ Electron microscopy, the most effective observation method of crystallographic defects which dominate mechanical properties of materials, is briefly discribed. Ultrasonic propagation phenomena depending on the elastic properties of materials and their applicaitons are also described.

Outline⟩ Mechanical properties of crystalline materials are dominated by microscopic lattice defects. In the first half of this lecture, transmission electron microscopy, a powerful experimental method for direct observation of microscopic defects in materials, is discussed. Emphasis is put on the understanding of crystal orientation determination from electron diffraction patterns, based on the idea of reciprocal lattice. In the last half of this lecture, basic properties of wave propagation for ultrasonic material characterizations are discussed. The aim of the lecture is to give ultrasonic propagation phenomena. Several theoretical deductions of the wave equation from the continuity equation, the Navier-Stokes equation, the equation of state and the energy conservation low, respectively, and wave simulations are also shown in the lecture.

Style⟩ Lecture

Keyword*⟩ *transmission electron microscopy

Fundamental Lecture⟩ "**Material Engineering**"(1.0)

Notice⟩ 2-hour study before and after each lecture is necessary.

Goal⟩

1. To understand the Ewald sphere construction for the analysis of electron diffraction patterns.
2. To understand the wave equation for 3-dimentional anisotropic solid material and computer simulation for wave-propagation.

Schedule⟩

1. Transmission electron microscope, Basic crystallography
2. Reciprocal lattice and diffraction
3. Indexing of electron diffraction pattern
4. Kikuchi pattern
5. Image from perfect crystal
6. Contrast from planar defects
7. Contrast from dislocations
8. Introduction of wave propagations and NDI techniques with ultrasounds
9. Displacement, stress and strain of 3-dimentional anisotropic solid material
10. Methematical deduction of wave equation for 3-dimentioal anisotropic solid material
11. Physical meanings of wave equation
12. Finite differential simulation of wave equation
13. Boundary descriptions for wave equation
14. Physics for ultrasonic guided waves
15. Methematics for SH mode guided waves
16. Examination

Evaluation Criteria⟩ Assignment 50%, Examination 50%

Reference⟩ 坂著「結晶電子顕微鏡学」(内田老鶴圃)

Contents⟩ http://cms.db.tokushima-u.ac.jp/cgi-bin/toURL?EID=216672

Contact⟩

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