Solid State Physics

Syllabus Number 2D204

Special Subjects
Elective 2 credit

HASHIMOTO, Keizo

1. Course Description

Early in the 20th century, quantum mechanics and relativity theory were born, modern physics have developed very rapidly since then. A. Einstein contributed very much to both theories, but he had refused to accept quantum mechanics until the end. Solid state physics clarifies the structure of the atom and electron cloud, based on the quantum physics. This course includes the derivation of Schrodinger's wave equation and its solution in the hydrogen atom. Crystal structure and X-ray diffraction theory will be discussed.

2. Course Objectives

This course presents an introduction to quantum mechanics, crystal structure and X-ray diffraction. Schrodinger's equation will be the starting point. The goal of this course is to understand, 1) the historical developments of quantum theory, 2)properties of particles and waves, 3) four quantum numbers to describe the electron cloud structure of the atom. Crystal is an aggregate of many atoms with the periodic motif. Crystal structure is identified by means of applying the X-ray diffraction theory.

3. Grading Policy

Final examination (80%),report (20%)

4. Textbook and Reference

Reference

T.Fujiwara, Kougakukiso Busseibuturigaku Suurikougakusy ISBN-13-978-4901683654
K.Sato Ryousiron wo tanosimu hon PHP Bunko ISBN4-569-57390-8

5. Requirements(Assignments)

Lecture note and related papers will be shown up in LMS. Student must pre-study scientific terms. Related topics with quantum mechanics will be seen in YouTube, please watch the contents. Homework will be shown in LMS.

6. Note

7. Schedule

[1] Before birth of quantum mechanics: History of physics (Copernicus, Kepler, Galileo and Newton)

[2] Birth of quantum mechanics 1: Concept of quantum by Plank and V.deBrogi

[3] Birth of quantum mechanics 2: Hydrogen atom model by Bohr

[4] Atom and electron state 1: Derivation of Schrodinger's wave equation

[5] Atom and electron state 2: Schrodinger's wave equation and Heisenberg's uncertainty principle

[6] Electron state of hydrogen 1: Solution of wave equation

[7] Electron state of hydrogen 2: Four kinds of quantum number

[8] One dimensional lattice and free electron model: Application of Schrodinger's wave equation

[9] Scattering of X-ray by atom: Atomic scattering factor

[10] Crystal from symmetry: Bravais lattice, unit cell Millar index

[11] X-ray diffraction 1: Bragg's diffraction condition

[12] X-ray diffraction 2: Diffraction by wave function

[13] Structure factor of crystal 1: Reciprocal lattice and Laue's diffraction condition

[14] Structure factor of crystal 2: Structure factors of FCC, BCC and NaCl and their X-ray diffraction patterns

[15] Final examination and summaries