

CHALMERS

An introduction to crystal structures

Introduction
Close-packing
Body-centred and primitive structures
Symmetry
Lattices and unit cells
Crystalline solids
Lattice Energy

Physical methods for characterizing solids

Introduction
X-ray Diffraction
Powder Diffraction
Single Crystal X-ray Diffraction
Neutron Diffraction
Electron Microscopy
Scanning Probe Microscopy, SPM
Atomic Force Microscopy, AFM
X-ray Absorption Spectroscopy, XAS
Solid-state Nuclear Magnetic Resonance Spectroscopy
Thermal Analysis
Temperature Programmed Reduction, TPR
Other Techniques

Add IR and Raman from Maths lecture notes

CHALMERS

Synthesis of solids

Introduction
High temperature ceramic methods
Microwave synthesis
Combustion synthesis
High pressure methods
Chemical vapour deposition (CVD)
Preparing single crystals
Intercalation
Synthesis of Nanomaterials
Choosing a method

Bonding in solids and their electronic properties

Bonding in solids—free electron theory
Bonding in solids - molecular orbital theory
Semiconductors—Si and Ge
Bands in compounds—Gallium Arsenide
Bands in d-block compounds—transition metal monoxides
Classical Modelling

CHALMERS

Defects and non-stoichiometry

Point Defects - an introduction
Defects and their concentration
Ionic conductivity in solids
Solid Electrolytes
Applications of solid electrolytes
Colour Centres
Non-stoichiometric compounds
Extended defects
Three-dimensional defects
Electronic properties of non-stoichiometric oxides

Microporous and Mesoporous solids

Zeolites
Other microporous framework structures
Mesoporous structures
New materials
Clay minerals

CHALMERS

Optical properties of solids

Introduction
The interaction of light with atoms
Absorption and emission of radiation in continuous solids
Refraction
Photonic Crystals
Metamaterials — ‘cloaks of invisibility’

Magnetic and Electrical Properties

Introduction
Magnetic susceptibility
Paramagnetism in metal complexes
Ferromagnetic metals
Ferromagnetic compounds - chromium dioxide
Antiferromagnetism - transition metal monoxides
Ferrimagnetism - ferrites
Spiral Magnetism
Giant, Tunnelling, and Colossal Magnetoresistance
Electrical polarisation
Piezoelectric crystals
The Ferroelectric Effect
Multiferroics

CHALMERS

Superconductivity

Introduction
Conventional superconductors
High temperature superconductors
Uses of high temperature superconductors

Nanostructures and solids with low-dimensional properties

Nanoscience
Consequences of the nanoscale
Low-dimensional and nano-structural carbon
Carbon-based conducting polymers
Non-carbon nanoparticles
Non-carbon nanofilms and nanolayers
Non-carbon nanotubes, nanorods and nanowires