

Lecture 1: X-ray Basic Physics, System Parameters and Qualitative Analysis - (Day 1)

- I. System Description
 - A. Components
 - 1. Spectrometer
 - 2. Electronics
 - B. Spectrometer resolution
 - C. Spectrometer efficiency
- II. Data Collection
 - A. Energy calibration
 - B. Count rate considerations
 - 1. Statistics
 - 2. (3 Sigma Rule)
- III. X-ray Physics
 - A. Generation of x-rays
 - 1. Characteristics of x-rays
 - 2. Continuum
 - 3. Artifact peaks
 - B. Moseley's Law
 - C. Beer's Law
- IV. Microscope/Detector Parameters
 - A. Sample/Detector geometry
 - B. Probe current
 - C. X-ray range (volume)
- V. Qualitative Analysis
 - A. Parameters
 - 1. Accelerating voltage
 - 2. Sample/Detector geometry
 - 3. Probe current/Count rate
 - B. Identification
 - C. Dealing with overlaps

Laboratory 1: X-ray Basic operation and Qualitative Analysis

- I. Overview of System (**Group**)
 - A. Detector
 - B. Analyzer
 - 1. Components
 - 2. Software
 - a. Version
 - b. Booting system
 - 3. Display
 - 4. Mouse/Keyboard operation
 - C. Calibration
 - D. General X-ray data collection
- II. Qualitative analysis and general operation (**Hands on**)
 - A. Display spectra
 - B. Spectra control
 - C. Identification
 - 1. Manual
 - 2. Computer-assisted
 - 3. Automatic
 - D. Checking detector efficiency
 - E. Handling overlaps

Lecture 2: Comparative Analysis - (Day 2)

- I. Comparative Analysis
 - A. Relative ratio/Match/Fingerprint Analysis
 - B. K-ratio
 - C. Concentration curve
 - D. Graphic techniques (Mapping, LPA, HyperMaps)
- II. General X-ray Techniques
 - A. Ideal sample
 - B. Sample charging
 - C. Rough surface/powder
 - D. Multi-phase
 - E. Thin films
 - F. Foils
 - G. Particles on substrate

Laboratory 2: Mapping, Line scan and Comparative Techniques

- I. Collection of SpotLight / Multi-point, X-ray maps, line profiles, PTS / HyperMap. (Group)
- II. Comparative Analysis

Lecture 3: Quantitative Analysis - (Day 3)

- I. Theory
- II. Background subtraction
- III. K-ratio/Deconvolution
- IV. Matrix correction
- V. Standards versus standardless
- VI. Microscope parameters
- VII. Description of Bruker Quantitative Programs

Laboratory 3: Quantitative Analysis (Hands on)

- I. Setting up quant
 - A. Take-off angle
 - B. Efficiency
- II. Standardless Analysis
- III. Partial standards analysis
- IV. Full standards analysis
- V. Rough surface/powder
- VI. Thin section (Cliff-Lorimar)
- VII. Hall
- VIII. Output

Lecture 4: Digital Image; Analysis and Processing - (Day 4)

- I. Terminology
- II. What is digital imaging?
- III. Sources
- IV. Calibration
- V. Image Processing
- VI. Math operations
- VII. Image Analysis

Laboratory 4: Digital Imaging

- I. Optimize image collection (Group)
- II. Basic display operations (Hands on)
- III. Feature Analysis (Hands on)