

## 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)