

10TH ADVANCES IN CEMENT-BASED MATERIALS

June 16 – June 18, 2019
University of Illinois at Urbana-Champaign
Champaign, IL USA

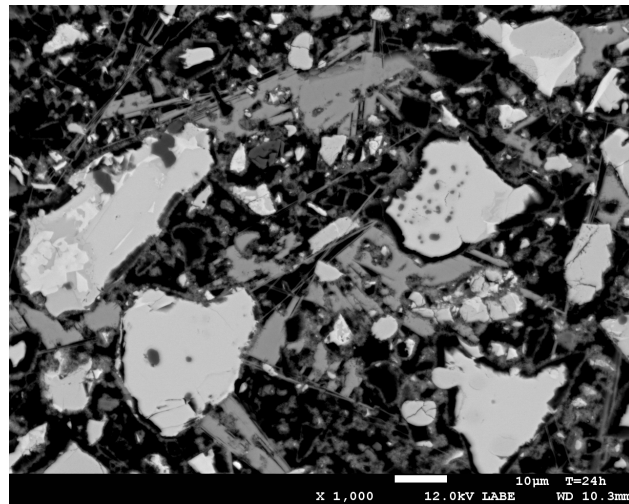
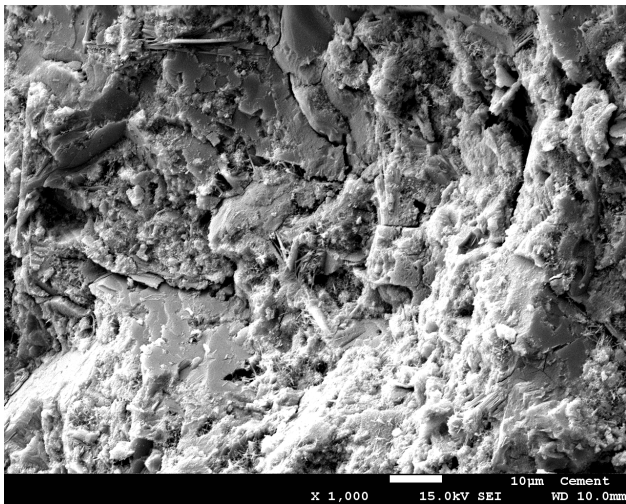


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Scanning Electron Microscopy and Image Analysis of Cementitious Materials

2 pm - 5 pm, June 16 at Newmark Civil Engineering Lab, 205 N Mathews Ave, Urbana 61801

The scanning electron microscope (SEM) is routinely used for the investigation of cementitious materials microstructure, complementing the information that can be obtained from X-ray diffraction and light microscopy by providing sub-micrometer definition of the material's structure and composition. Image processing and analysis can be used to quantify microstructural features through a combination of information from backscattered electron images of phase composition and X-ray imaging of element spatial distribution.



Secondary electron (left) and backscattered electron (right) SEM images of a hardened cement paste at 24 h, showing the residual cement, hydration products, and porosity.

This three-hour short course will introduce participants to quantitative SEM methods for acquiring and interpreting microstructural and chemical information on cementitious materials. Topics will cover SEM imaging modes, methods for preparing specimens, strategies for imaging different types of materials, and quantitative image processing and analysis. Participants will receive practical guidance that can be applied to improve their imaging and characterization capabilities in their own labs.

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Course Outline

1. Introduction to Petrographic Methods for Cement and Concrete
2. The Scanning Electron Microscope
 - 2.1. Secondary electron imaging
 - 2.2. Backscattered electron imaging
 - 2.3. X-ray microanalysis and imaging
3. Specimen Preparation
 - 3.1. Equipment and materials
 - 3.2. Clinker, cement, and pozzolans
 - 3.3. Hardened cement paste, mortar, and concrete
 - 3.4. Polishing procedures
 - 3.5. Specimen coating for SEM
4. SEM Imaging Strategies
5. Quantitative Image Analysis for Microstructure and Composition
 - 5.1. Image preprocessing
 - 5.2. Multispectral methods for phase identification
 - 5.3. Quantitative microstructure measurements

Outcomes

At the end of the course, participants will

- be able to distinguish different SEM imaging modes and their characteristics;
- know the steps of specimen sampling and preparation for SEM imaging for different kinds of materials
- be familiar with software tools and methods for quantitative phase identification and microstructural analysis