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Microscopy AND Microanalysis

Introduction: Special Issue on Cathodoluminescence

Cathodoluminescence (CL) microanalysis provides high-sensitivity spectra and high-resolution images associated with impurity and structural defects at the nanoscale and from luminescent materials including minerals, semiconductor, and dielectric/insulating materials. Cathodoluminescence is the non-incandescent emission of light (photons) emitted from materials excited by an electron beam. CL photons (UV-VIS-NIR) are produced as a result of electronic transitions between the conduction and valence band and may also involve electronic transitions associated with defect levels within the band gap. Microscopic defects such as imperfections and impurities influence the optical, electrical, and mechanical properties of scientifically and technologically important materials. CL microanalysis is therefore a useful microanalytical technique for characterizing these properties with high sensitivity and spatial resolution. CL image resolution can range from sub-10 nm to microns, dependent on experimental arrangement (STEM-CL, SEM-CL, optical CL microscopy), electron beam parameters, specimen configuration, carrier diffusion, etc. The sensitivity of CL microanalysis is dependent on the specimen and, in the absence of self-absorption and competitive recombination centers, can be several magnitudes more sensitive than X-ray microanalysis. In particular, quantitative CL microanalysis of trace impurity concentrations while challenging has recently been shown to be possible for a range of minerals.

Since 2002, the Microanalysis Society (MAS) has partnered with other professional societies and institutions to host a series of very successful topical conferences on advances in specialist microscopy and microanalysis techniques. *Cathodoluminescence 2011* is the tenth of this series of topical conferences and was held at the National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA on October 24–28, 2011. *Cathodoluminescence 2011* was co-sponsored by the Australian Microbeam Analysis Society (AMAS) and generously supported by Gatan, Ocean Optics, FEI Company, JEOL USA, Attolight, Horiba Scientific, ThermoFisher Scientific, Leica Microsystems, and Buehler.

Cathodoluminescence 2011 included platform and poster presentations, sponsor presentations, laboratory demonstrations, CL-software demonstrations, and "roundtable" discussions, as well as informal opportunities to discuss and interact. In particular, the NIST venue provided the opportunity for extended interactive laboratory demonstrations of hyperspectral UV, VIS, and IR CL techniques across three advanced field emission microscope platforms. The scientific and technical program covered a broad range of topics including planetary and geosciences applications, nanostructured and advanced materials analysis, semiconductor and optoelectronic device applications, forensic applications, advances in CL instrumentation, depth-resolved CL, hyperspectral techniques, correlative analysis of CL with complementary (micro)analytical techniques, etc. The scientific and technical areas covered represent key active areas of CL research and technique development. This special issue of *Microscopy and Microanalysis* arises from some of the original research presented at *Cathodoluminescence 2011*. Additional conference content can be found at www.microbeamanalysis.org/topical-conferences/cl-2011/.

Access to the laboratories of the Microanalysis Research Group in the Surface and Microanalysis Science Division of NIST and the contributions of the local organizing committee—Paul Carpenter, Jeff Davis, and Ed Vicenzi—are gratefully acknowledged. In addition, the National Science Foundation's (NSF) Division of Earth Sciences generously provided support for student participation in CL2011. The NSF award was issued to local organizer Ed Vicenzi by way of the Instrumentation and Facilities Program (EAR-1201942) to support costs incurred by U.S. students who attended the conference. The editors of *Microscopy and Microanalysis*, Jay Jerome and Bob Price (editor in chief), are also gratefully acknowledged for their advice and support with this special issue.

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