From the Editor

Progress in Microanalysis

Many researchers view microanalysis as the determination of composition and structure of individual phases at a spatial resolution of 1 μm or better. It is remarkable to me that much of what we know about the phases shown in equilibrium phase diagrams was determined using bulk analysis techniques like powder X-ray diffraction in combination with light microscopy of flat-polished sections of materials. The identities and amounts of phases were deduced from systematic experiments because there was no way to analyze micrometer-sized phases *in situ*.

A breakthrough came in 1951 when Castaing showed that a focused electron beam could generate measurable characteristic X rays from single-phase regions at a spatial resolution of 1 μm. This technique may be termed electron probe microanalysis (EPMA) when accomplished in special-purpose instruments or X-ray emission spectrometry (XES) when performed in the scanning electron microscope (SEM). About this same time electron diffraction of thin specimens could provide complementary crystal structure information from crushed sub-micrometer phases analyzed in the transmission electron microscope.

In 1973 Venables and Harland showed that electron diffraction information could be obtained in the SEM from focused electron beams stopped within individual phases of bulk solids. With electronic acquisition of these diffraction patterns and computer-based processing and analysis of the information, this technique developed into the electron backscatter diffraction (EBSD) we know today.

In modern SEMs, XES and EBSD work together to yield quantitative analyses of compositions and crystal structures within sub-micrometer phases. Indeed, X-ray maps of element distributions and maps of crystal grain orientations are key tools for microanalysis investigations in many fields.

The special section in this issue shows that progress in these techniques continues. Hombourger and Outrequin demonstrate that adding a field-emission electron source to an EPMA employing wavelength-dispersive X-ray spectrometers allows high-spatial resolution analysis at low electron beam energies. Geiss et al. explain how high-spatial resolution diffraction data can be obtained in transmission with commercial EBSD detection systems. Finally, Barbi and Mott produce improved correlations of SEM images with XES data by attaching a new design of electron detector to the end of the X-ray detector.

Editor-in-Chief
Charles Lyman

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