From the Editor

X-ray Microscopy in your Lab

Using X rays to produce magnified images of objects has been a goal for 150 years. Ever since Ernst Abbe declared in 1873 that light microscope resolution was limited by the wavelength of light, the search was on for a microscopy medium with a wavelength shorter than visible light (< 500 nm). When Roentgen discovered X rays in 1895, it was thought that the new medium may have been found. Soon it was clear, however, that it was not easy to construct a physical lens for X rays because the rays penetrated all lens construction materials. X-ray "radiography images" of a few times magnification were possible but only as projection images, formed as X rays from millimeter-sized sources traveled in straight lines through the specimen to be captured on film. Unfortunately, even in the best cases, useful magnification was limited by the relatively large "point source" of X rays and the large grain size of X-ray film (both about 0.1–1.0 mm).

Thus, the accelerated electron, with its much smaller wavelength, became the first medium that allowed a better microscope. In 1934 Ruska demonstrated an electron microscope with resolving power and magnification greater than the light microscope. But the search continued for a way to produce higher resolution X-ray micrographs. Several X-ray microscopes were made in the 1950s, including Newberry's commercial instrument manufactured by General Electric. While useful images were demonstrated at conferences, interest in the technique waned until the advent of synchrotron X-ray sources and computed tomography fostered the development of many new methods and devices. While today synchrotron facilities produce high-quality X-ray micrographs, it has always been a goal to use X-ray microscopy in the typical research lab to complement other analytical methods.

Over the last four decades, there has been continual improvement in smaller laboratory-based sources. High-brightness rotating anodes and, soon, liquid-metal, jet-based laboratory sources provide higher X-ray fluxes, permitting dynamic *in situ* radiographic studies that formerly were the purview of synchrotrons. Detectors also have improved with smaller pixel sizes (improving resolution) and faster detector read-out electronics. Three-dimensional tomographic images reveal internal specimen morphology at near-SEM resolution non-destructively. Projection views of internal specimen features, even at modest resolution, can be of great utility in selecting specimens, preparing specimens, and locating regions of interest for high resolution SEM or TEM.

The articles in this issue show that powerful X-ray microscopy now can be accomplished with laboratory-based systems. Thus, the technique now complements both light microscopy and electron microscopy in the core microscopy facility. I thank Editorial Board member Brian M. Patterson for assistance with this editorial.

Editor-in-Chief
Charles Lyman

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