Orientated Imaging Microscopy

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With the complexity of polycrystalline materials, a number of techniques have evolved to assist in the resolution of the crystallography of these materials. Conventional methods provide partial information regarding grain size, and can produce estimated orientation distributions. However, these techniques have not been able to provide the spatial placement of lattice orientations, which is necessary for a complete picture of the microstructure of a materials sample. Furthermore, many materials characteristics, such as fracture and corrosion, are determined by site-specific, rather than average, crystallographic features.

A number of years ago it was recognized that electron backscattered diffraction patterns (EBSP) could be used to obtain site-specific orientation information. Systems were developed for the capture and analysis of these patterns, but tedious work by a trained crystallographer was required, creating a practical limitation of a few hundred measurements per day. Orientation Imaging Microscopy (OIM) is a powerful new automated EBSP technique for analyzing local texture and grain boundary structure of polycrystalline materials.

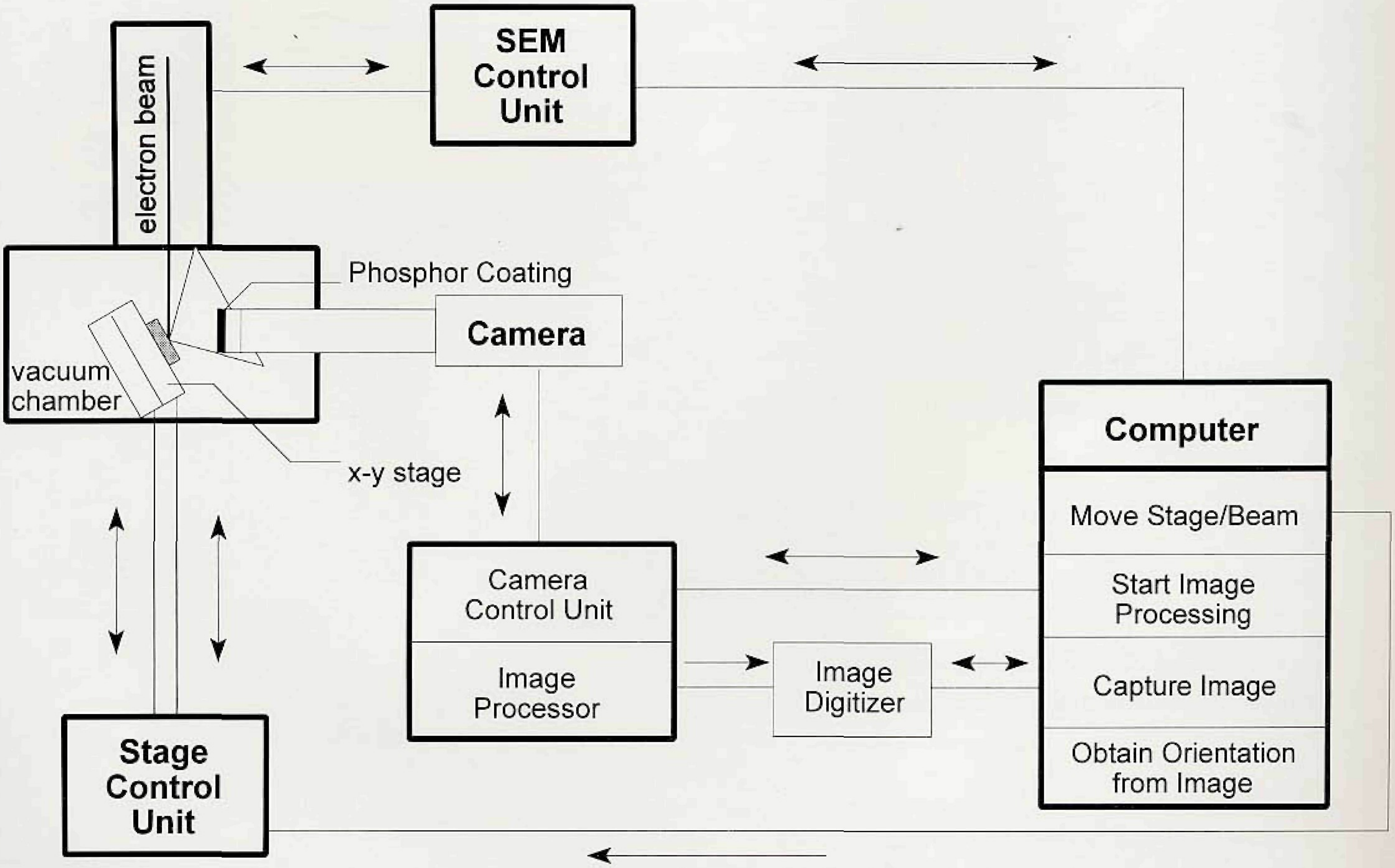
The power of OIM lies in allowing materials scientists to perform unprecedented texture analysis of microstructures, yielding thousands of spatially specific orientation measurements within minutes. Additionally, it employs powerful and versatile image processing capabilities to allow visualization of the microstructure according to the interests of the scientist.

OIM utilizes high resolution video camera technology integrated with a scanning electron microscope to capture electron backscattered patterns in real time (see the accompanying figure). These images are enhanced, passed to a Windows personal computer or a Unix-based workstation and processed by sophisticated crystallographic software. The output is a database of x-y coordinates, local lattice orientation, and image quality measurements which can be correlated with strain. From one to thousands of intragranuallar measurements can be obtained, depending on the research objectives.

Using these data a wealth of post-processing analyses can be performed using OIM software. The most unique is the Orientation Imaging Micrograph, which is a map of the grain morphology constructed from the set of orientation measurements. This map may be manipulated in show features of interest relevant to the particular needs of the user. Shading of the grains (in various colors or gray levels) can be dependent upon grain size, lattice orientation, plastic deformation (quality of EBSP image), or colored strategically to emphasize grain morphology. Grain boundaries may be drawn in varying colors and thicknesses depending upon misorientation angle, specialness according to CSL theory, or user-defined parameters.

The potential uses of OIM are numerous. For example, consider a deformed, low stacking-fault energy, dislocation cell forming, fcc material. The user might wish to draw boundaries of 1 to 5 degrees in a thin black line, and boundaries of higher misorientation in thicker black lines. Twin boundaries could be highlighted in red and grain shading could be performed according to image quality so regions of localized plastic strain would be identified. By viewing such a strategically generated map, locations of the dislocation cells and regions of high strain may be immediately visible by the thin black lines and darker shading on the image. Grain morphology including twin boundaries is seen in connection with this.

Additional examples demonstrating the utility of OIM include specimens with cracks, which are typically identified by poor EBSP image quality measures readily visible on the OIM, and comparison of the spatial distribution of specific texture components through the structure, which may be colored according to orientation. ■



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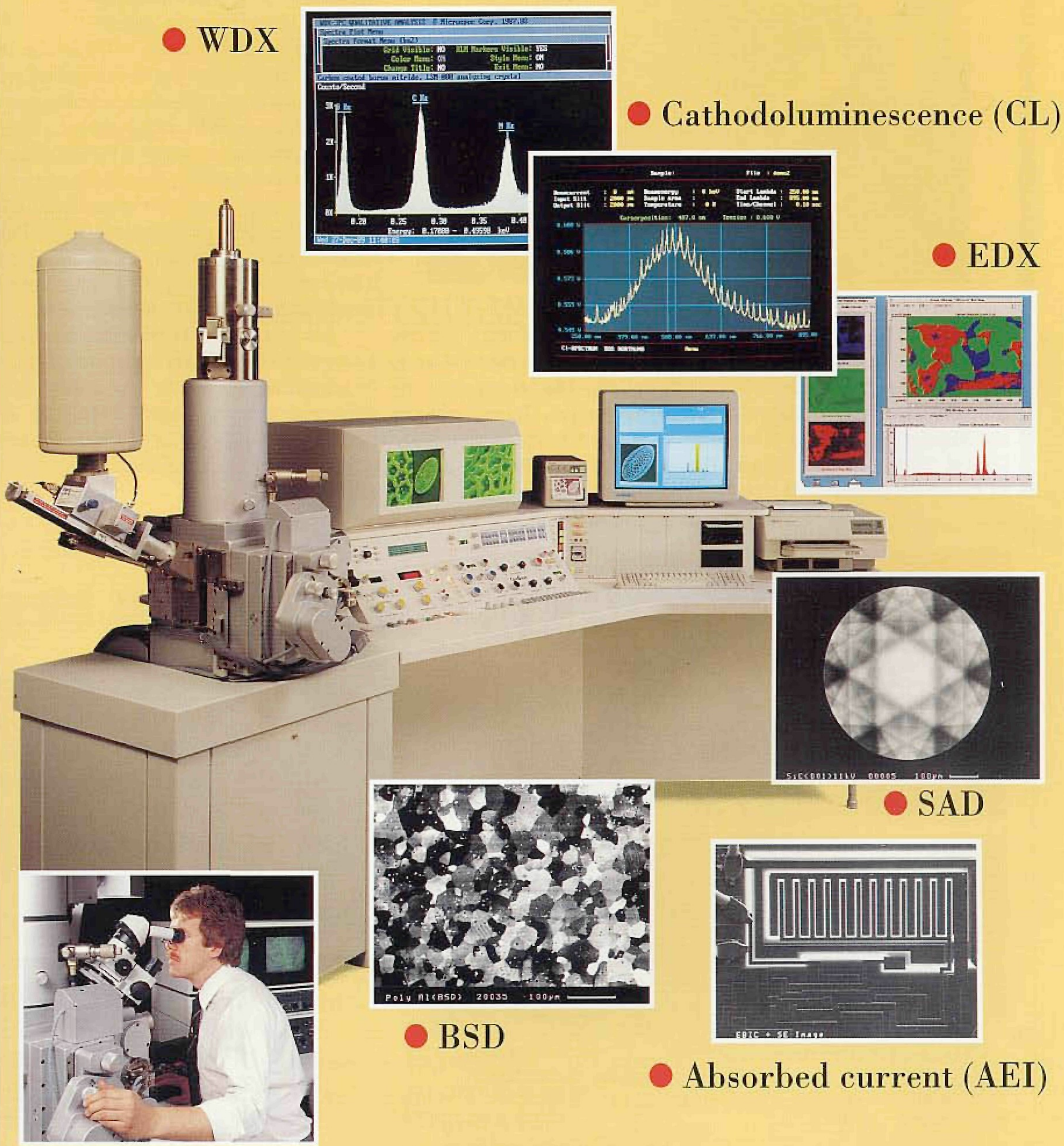

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