

SCANNING ELECTRON MICROSCOPY/1975

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Part II

SCANNING ELECTRON MICROSCOPY AND THE LAW

Part III

TEACHING OF SCANNING ELECTRON MICROSCOPY

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and
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LIST OF SYMBOLS FOR IITRI PROCEEDINGS

1. <u>Microscope Constants</u>	a_v Auger electron yield ($1 - a_v = w_v$) (subscript appropriate shell)
C_s spherical aberration coefficient (cm)	k incident wave vector
C_c chromatic aberration coefficient (cm)	g reciprocal lattice vector
d_o diameter of electron probe without aberrations	ξ extinction distance for reflection g
d_s diameter of electron probe due to spherical aberration	s deviation parameter
d_c diameter of electron probe due to chromatic aberration	R penetration distance of incident electron beam
d_f diameter of electron probe due to diffraction	z electron travel perpendicular to surface
d resultant final diameter of electron probe	x actual electron trajectory
M linear magnification of instrument, spot size/source size	S electron stopping power, $dE/d(\rho x)$
W focal length of lens (cm)	ρ material density (g/cm^3)
λ incident electron wavelength	E instantaneous electron energy (eV)
E_o incident beam voltage (volts)	e electronic charge
I_B incident beam current (amps)	A atomic weight
β electron gun brightness (amps/cm ² sterad)	Z atomic number
J_c cathode current density in gun (amps/cm ²)	θ_B Bragg angle
J current density in beam (amps/cm ²)	μ mass absorption coefficient
ϕ angle between specimen surface normal and electron beam	μ_L linear absorption coefficient
θ semi-scan angle	e mean ionization potential
α_i angle of divergence subtended by incident beam (radians)	3. <u>Variables Related to X-Ray Analysis</u>
α_o angle subtended at specimen by collection aperture (e.g., in STEM)	ψ X-ray take-off angle
B amplifier or system bandwidth (Hz)	Ω total solid angle seen by collector (sterads)
C image contrast (defined as I_{max}/I_{min})	n_B background count rate
G system gain	n_T unknown count rate
2. <u>Variables Related to Electron-Specimen Interaction</u>	n_o net count rate ($n_T - n_B$)
η backscattering coefficient	t counting time
δ_p secondary electron coefficient for electrons produced by incident beam	τ dead time
δ_n secondary electron coefficient for electrons produced by backscattered electrons	D detector efficiency
δ total secondary coefficient ($\delta = \delta_p + \delta_n$)	E_j critical excitation potential (subscript appropriate shell)
w_v fluorescent X-ray yield (subscript appropriate shell)	U overvoltage ratio (E_o/E_j)
	C_{DL} minimum detectability limit (no definition implied)
	C_{std} concentration of standard
	r_f fluorescence correction factor
	f absorption correction factor
	All other symbols in accordance with SI system.

PREFACE

These proceedings, as the past seven volumes, include the complete text of all papers presented at the 1975 Eighth Annual Scanning Electron Microscope Symposium (Part I), and two Workshops: Scanning Electron Microscopy and the Law (Part II), and the Teaching of Scanning Electron Microscopy (Part III). In addition, several new tutorial papers and three bibliographies--SEM and the Law (p. 589), SEM in Materials Sciences (p. 763), and an update of the SEM and the Plant Sciences bibliography of last year (p. 737) are also included. We are grateful to the authors for sending us reprints for inclusion in these bibliographies, and apologize that bibliographies on all subjects were not prepared. We hope to continually prepare updates and complete new bibliographies for inclusion in future proceedings. Several of the papers in these proceedings were invited review papers.

The SEM Symposium continues to concentrate on papers of maximum overall interest to current and potential users of scanning electron microscopes and related techniques. The SEM and the Law Workshop, as a follow-up to the 1971 Workshop on Forensic Applications of the SEM, aims at a critical discussion of medical and non-medical SEM applications appropriate for past or existing legal questions. Several papers and their discussions highlight the problems of getting SEM results accepted by courts. The teaching sessions were planned to provide material for potential teachers to start their own courses. The model lectures, of specific interest to teachers, provide a valuable review for all readers.

Magnifications for all micrographs are indicated by micron marks or by width of field, since the photographs are reduced during reproduction. A list of symbols was sent to each author for use in preparation of his manuscript. This list is included on p. xiv. However, please note that some authors have used their own symbols, which are then defined in their respective papers. In addition to the symbols, information on the availability of several proceedings referred to in this volume is included on p. viii.

The reviewing of papers was continued along the lines used for the past proceedings. One important consequence of the rapid growth of scanning electron microscopy is that reviewing has become more and more critical. This is reflected in the fact that nearly 20% of the papers were found unacceptable at the manuscript stage, and nearly 40% of the papers published here were totally or partially revised. All discussions with reviewers and authors' replies were edited here and made a part of each paper. We apologize to the reviewers and the authors if the meanings of their questions or answers were inadvertently altered during editing. We have been most encouraged by the unanimous approval of this unique "Discussion with Reviewers" feature of these proceedings and strongly urge the readers to read the discussions with the papers.

Although the deadline for papers was January 16, 1975, some were not received in completed form until late in February. Considering the size of the volume, the very short time available for preparation, and that it is ready for distribution by April 7, 1975, its very existence is made possible only by the dedicated hard work and cooperation between the authors and the reviewers. For this, we thank all of them most sincerely.

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FUTURE GROWTH OF SEM - TOWARD SUPER EFFICIENT MICROSCOPY

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KEYNOTE PAPER

ABSTRACT

Some predictions concerning future trends in the SEM field have been made. Economic and personnel considerations have been taken into account in arriving at these predictions. Micrographic and analytical requirements and capabilities were also considered. For electron transparent specimens, scanning transmission electron microscopy (STEM) will become a major research method. Auger and energy loss spectrometry will join X-ray emission as analytical methods used for the analysis of such samples. Greater advantages will probably arise from improvements in electron source brightness and from advantages afforded by low energy loss electron detectors. Finally, the SEM field can only profit as the quality and quantity of educational opportunities in the field expand.

KEY WORDS: Auger Electron Spectrometry; Electron Probe X-ray Microanalysis; Energy Loss Spectrometry; Scanning Electron Microscopy; Scanning Transmission Electron Microscopy