Electron Energy Loss Spectroscopy

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Electron energy loss spectroscopy (EELS) is able to provide information on elemental concentration, crystal structure, electronic structure, and chemistry of materials at very high spatial resolution [1]. It has been widely applied to and will play a more significant role in the research of advanced materials [2]. This chapter will review the physics, instrumentation, and applications of EELS, organized as follows:

1. Introduction of EELS.

2. Physics of EELS, covering (1) Electronic Structure of Atoms and Solids; (2) Electron-Matter Interactions; (3) Elastic Scattering; (4) Inelastic Scattering; (5) Single, Plural, and Multiple Scattering; (6) Formulation of Scattering.

3. Instrumentation and Experimental Aspects of EELS, covering (1) Instrumentation of EELS; (2) Experimental Parameters; (3) Specimen Aspects; (4) Detector Backgrounds.

4. Processing of EELS Spectra, covering (1) Components of a EELS Spectrum; (2) Removal of Background; (3) Extraction of Zero-Loss Peak; (4) Removal of Plural Scattering.

5. Quantification of EELS Spectrum, covering (1) Specimen Thickness; (2) Plasmon Peak; (3) Surface Plasmon Peak; (4) Interband Transition Peaks; (5) Elemental Analysis of Core-loss Edges; (6) Energy Loss Near Edge Structure; (7) Extended Energy Loss Fine Structure; (8) Simulation of EELS Spectrum.

6. EELS Imaging, covering (1) Energy Filtered Transmission Electron Microscopy; (2) Energy Filtered Imaging; (3) Energy Filtered Diffraction; (4) EFTEM Spectrum Imaging; (5) STEM Spectrum Imaging.

7. Applications to Diluted Magnetic Semiconductors (DMS), including (1) introduction of DMS; (2) Experimentals; (3) Results and Discussion; (4) Conclusion and Outlook.

8. Comparison with Other Techniques and Conclusion

Keywords Electron Energy Loss Spectroscopy; Diluted Magnetic Semiconductors