

BOOK REVIEW

THEORY OF REFLECTANCE AND EMITTANCE SPECTROSCOPY. By B. HAPKE
Cambridge University Press, Cambridge, 2005. ISBN 0 521 61927 0. 247 × 188 mm. xiii + 455 pages. Illustrated. Price £35.00 paperback. Note: This is the first paperback edition of a book first published in 1993.

“THE EQUATION YOU NEED THE MOST contains a typographical error [...]”: that is Murphy’s Law jokingly rearranged by Bruce Hapke, the asteroid man (an asteroid discovered in 1973 by Ted Bowell was named “3549 Hapke”, explicitly dedicated to Bruce Hapke), who in this book shows great capability in explaining in a robust but straightforward manner the complex concepts of reflectance and emittance spectroscopy of planets.

After a brief introduction (Chapter 1) about the scientific rationale for the book, Chapter 2 provides the reader with Maxwell’s equations and generalities about electromagnetic wave propagation. Absorption of light is discussed in Chapter 3, robustly dealing with the Drude and Lorentz models for the behaviour of conductors and insulators, respectively. Mechanisms of absorption including molecular rotation, lattice vibrations, electronic transitions and free carriers are then reviewed. Fresnel equations describing wave reflection and transmission by a plane boundary form the bulk of Chapter 4, mainly focusing on specular reflection. A fascinating part of the chapter deals with surface roughness versus optical flatness. Chapters 5 and 6 cover single particle scattering, considering regular and irregular particles, respectively.

Leaving behind wave and particle spectroscopy, the next six chapters (Chapters 7 to 12) deal with reflectance in particulate media. Chapter 7 introduces the equation of radiative transfer starting from the Maxwell–Garnett effective medium expression and delves deeply into both emission and extinction (scattering and absorption) analytical solutions. Chapters 8 and 9 are mainly dedicated to bidirectional reflectance of plane-parallel media with random particle orientation and layered media, respectively. BDRFs (bidirectional reflectance factors) and albedo are treated in Chapter 10 while Chapter 11 presents applications to reflectance spectroscopy of the previously described theoretical expressions. Chapter 12 ends the section by extending concepts on bidirectional reflectance of a smooth medium to media showing a surface roughness.

Emissivity and emittance are approached in Chapter 13. It is worth noting that, while a major part of the book is dedicated to reflectance spectroscopy, emittance spectroscopy is only considered within this chapter. Nonetheless, reflectance laws are expected to be complementary to those of emittance thus promoting the choice made by the author. Light polarisation ends the book (Chapter 14), focusing on components of the electric fields composing electromagnetic radiation. A useful table of symbols and three straightforward mathematical appendices help the reader deal with vector calculus, complex variables and the wave equation in spherical coordinates.

Readers approaching this book should keep in mind that a robust background in mathematics and physics is needed in order to understand it fully. Nonetheless, a fascinating trip over spectroscopy theory and related formulae is brilliantly presented by the author, making the text indispensable for researchers involved in remote sensing.

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