

Contents

1. Introduction	1
2. Metal Optics in the Hydrodynamic Approximation	6
2.1 Plasma Waves, Nonlocality, Spatial Dispersion	6
2.2 The Hydrodynamic Model for Simple Metals	8
2.3 The Additional Boundary Conditions	10
2.4 The Additional Boundary Conditions at a Free Surface	12
2.5 The Energy Theorem for Combined Transverse and Longitudinal Fields	14
2.6 The Additional Boundary Conditions at an Interface Between Two Metals of Different Electron Density	17
2.7 Extension to Not-Nearly-Free Electron Metals	19
3. Applications of Nonlocal Metal Optics	22
3.1 Reflection and Transmission	22
3.2 Resonances in Thin Metal Films	28
3.3 The Surface Plasmon Dispersion	29
3.4 Standing Wave Eigenmodes in Thin Surface Layers	36
3.5 Optical Properties of Metal Layers on Metal Substrates	41
3.6 Electreflectance Spectra at Silver Surfaces	43
3.7 Ellipsometry from Metal Surfaces	46
3.8 Resonances in Small Metal Spheres	48
3.9 The Electric Fields Near the Surface Inside the Metal	52
3.10 The Photoemission Yield from Metal Surfaces	55
3.11 Different Additional Boundary Conditions	58
4. Theoretical Concepts and Models of Metal Surface Response	62
4.1 Additional Boundary Conditions or Susceptibility	62
4.2 Green's Functions for an Extended Hydrodynamic Model	65
4.3 The Specular Reflection Model	70
4.4 Microscopic Response Theory	73
4.5 Collective and Single-Particle Response in the SCIB Model	79

5. Description of Nonlocal Effects by the Surface Response Functions	
$d_{\perp}(\omega)$ and $d_{\parallel}(\omega)$	89
5.1 Economical Presentation of Experimental Results: $d_{\perp}(\omega)$, $d_{\parallel}(\omega)$	89
5.2 Boundary Conditions for the Asymptotic Fields	91
5.3 The Long-Wavelength Limit	96
5.4 Local Model for the Surface Region	102
5.5 Nonlocal Layer Model in the Hydrodynamic Approximation	107
5.5.1 No Surface Layer	110
5.5.2 Local Limits	112
5.5.3 Long Wavelength Limit	113
5.6 Surface Plasmons	116
5.6.1 Feibelman's Treatment	116
5.6.2 Additional Surface Plasmon Modes	118
5.6.3 Experimental Evidence for Multipole Surface Plasmons	120
5.7 Résumé	123
References	125
Subject Index	131

