Contents

	Acknowledgments vii
1	Introduction 1
2	Marcus Theory of Electron Transfer 5
3	Photosynthetic Reaction Center Models 7
4	Electron Donor–Acceptor Dyads 11
5	Supramolecular Electron Transfer 25
5.1	Cation–Anion Binding 25
5.2	π -Complexes 35
5.3	Electron-Transfer Switching 46
5.4	Dendrimers 53
5.5	Supramolecular Solar Cells 55
6	Effects of Metal Ions on Photoinduced Electron Transfer 65
7	Photoredox Catalysis 69
7.1	Photocatalytic Oxygenation 69
7.2	Photocatalytic Oxibromination 77
7.3	Carbon—Carbon Bond Formation 77
7.4	DNA Cleavage 81
7.5	Anti-Markovnikov Hydroetherification 81
7.6	Photocatalytic Cycloaddition 83
7.7	Photocatalytic Hydrotrifluoromethylation 85
7.8	Photocatalytic Hydrogen Evolution 86
8	Hydrogen Storage 93
8.1	Interconversion Between Hydrogen and Formic Acid 95
8.2	Interconversion Between Hydrogen and NADH 101

Contents	
8.3	Hydrogen Evolution from Alcohols 104
8.4	Hydrogen Evolution from Paraformaldehyde 107
9	Metal Ion-Coupled Electron Transfer (MCET) 109
9.1	MCET of O ₂ 109
9.2	Binding Modes of Metal Ions 114
9.3	Self-Organized MCET 124
9.4	Accelerating and Decelerating Effects of Metal Ions 132
9.5	Driving Force Dependence of MCET Rate Constants 137
9.6	MCET Coupled with Hydrogen Bonding 143
9.7	MCET Catalysis 148
9.7.1	Hydride Transfer vs. Cycloaddition 148
9.7.2	Suproxode Disumutase (SOD) Models 152
9.8	MCET of Metal-Oxo Complexes 157
9.9	PCET of Metal-Oxo Complexes 162
9.10	Unified Mechanism of MCET and PCET of Metal-Oxo
	Complexes 165
9.11	MCET of Metal-Peroxo Complexes 169
10	Catalytic Reduction of O ₂ 173
11	Catalytic Oxidation of H ₂ O 181
12	Production of Hydrogen Peroxide from Water and Oxygen as a Solar Fuel 187
13	Production and Usage of Hydrogen Peroxide as a Solar Fuel in Seawater 193
14	Photosystem II Mimic 197
15	Conclusion and Perspective 201 References 203

Index 225