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Nota di contenuto	1. Introduction -- 2. Spectroscopic techniques for studying optical properties of nanomaterials. 2.1. UV-visible electronic absorption spectroscopy. 2.2. Photoluminescence and electroluminescence spectroscopy. 2.3. Infrared (IR) and Raman vibrational spectroscopy. 2.4. Time-resolved optical spectroscopy. 2.5. Nonlinear optical spectroscopy : harmonic generation and up-conversion. 2.6. Single nanoparticle and single molecule spectroscopy. 2.7. Dynamic light scattering (DLS). 2.8. Summary -- 3. Other experimental techniques : electron microscopy and X-ray. 3.1. Microscopy : AFM, STM, SEM and TEM. 3.2. X-ray : XRD, XPS, and XAFS, SAXS. 3.3. Electrochemistry and photoelectrochemistry. 3.4. Nuclear magnetic resonance (NMR) and electron spin resonance (ESR). 3.5. Summary -- 4. Synthesis and fabrication of nanomaterials. 4.1. Solution chemical methods. 4.2. Gas or vapor-based methods of synthesis : CVD, MOCVD and MBE. 4.3. Nanolithography techniques. 4.4. Bioconjugation. 4.5. Toxicity and green chemistry approaches for synthesis. 4.6. Summary -- Optical properties of semiconductor nanomaterials. 5.1. Some basic concepts about semiconductors. 5.2. Energy levels and density of states in reduced dimension systems. 5.3. Electronic structure and electronic

properties. 5.4. Optical properties of semiconductor nanomaterials. 5.5. Doped semiconductors : absorption and luminescence. 5.6. Nonlinear optical properties. 5.7. Optical properties of single particles. 5.8. Summary -- 6. Optical properties of metal oxide nanomaterials. 6.1. Optical absorption. 6.2. Optical emission. 6.3. Other optical properties : doped and sensitized metal oxides. 6.4. Nonlinear optical properties : luminescence up-conversion (LUC). 6.5. Summary -- 7. Optical properties of metal nanomaterials. 7.1. Strong absorption and lack of photoemission. 7.2. Surface plasmon resonance (SPR). 7.3. Correlation between structure and SPR : a theoretical perspective. 7.4. Surface enhanced Raman scattering (SERS). 7.5. Summary -- 8. Optical properties of composite nanostructures. 8.1. Inorganic semiconductor-insulator and semiconductor-semiconductor. 8.2. Inorganic metal-insulator. 8.3. Inorganic semiconductor-metal. 8.4. Inorganic-organic (polymer). 8.5. Inorganic-biological materials. 8.6. Summary -- 9. Charge carrier dynamics in nanomaterials. 9.1. Experimental techniques for dynamics studies in nanomaterials. 9.2. Electron and photon relaxation dynamics in metal nanomaterials. 9.3. Charge carrier dynamics in semiconductor nanomaterials. 9.4. Charge carrier dynamics in metal oxide and insulator nanomaterials. 9.5. Photoinduced charge transfer dynamics. 9.6. Summary -- 10. Applications of optical properties of nanomaterials. 10.1. Chemical and biomedical detection, imaging and therapy. 10.2. Energy conversion : PV and PEC. 10.3. Environmental protection : photocatalytic and photochemical reactions. 10.4. Lasers, LEDs, and solid state lighting. 10.5. Optical filters : photonic bandgap materials or photonic crystals. 10.6. Summary.

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#### Sommario/riassunto

Optical properties are among the most fascinating and useful properties of nanomaterials and have been extensively studied using a variety of optical spectroscopic techniques. A basic understanding of the optical properties and related spectroscopic techniques is essential for anyone who is interested in learning about nanomaterials of semiconductors, insulators or metal. This is partly because optical properties are intimately related to other properties and functionalities (e.g. electronic, magnetic, and thermal) that are of fundamental importance to many technological applications, such as energy conversion, chemical analysis, biomedicine, optoelectronics, communication, and radiation detection. Intentionally designed for upper-level undergraduate students and beginning graduate students with some basic knowledge of quantum mechanics, this book provides the first systematic coverage of optical properties and spectroscopic techniques of nanomaterials.

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