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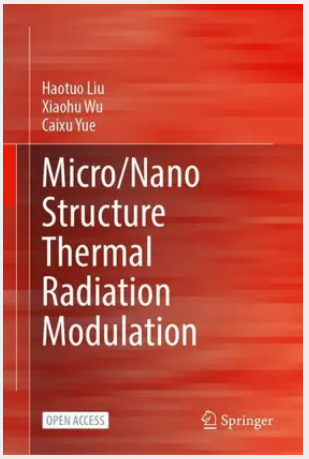
Micro/Nano Structure Thermal Radiation Modulation



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This open access book aiming at the current problems such as a single thermal radiation modulation mode, this book proposes an active modulation method of thermal radiation characteristics based on temperature-voltage coupling, which reveals the potential physical mechanism through the electric field distribution at different wavelengths and the power dissipation density distribution, and considers the effects of incident angle, polarization angle, and geometrical parameters on the spectral radiation characteristics. The spectral radiation modulation of one-dimensional periodic micro-nano-structures is investigated, and a theoretical model of smooth-type periodic structures is established to analyze the influence of the rotation angle of the crystal axis on the spectral radiation characteristics. With the help of equivalent medium theory, the two-dimensional periodic micro-nano-structures are equivalent to a gradient refractive index medium along the z-axis direction, and their broadband absorption properties are explained with the refractive index matching theory. On this basis, the spontaneous radiation modulation of a single-layer flat plate structure is investigated by taking the biaxial hyperbolic material a-phase molybdenum trioxide (a-MoO3) as an example, and the relationship between the Purcell factor and the rotation angle of the crystal axis of a-MoO3 when the crystal axis is rotated in different planes is discussed respectively. The modulation phenomenon is interpreted by the distribution of the reflection coefficients in the space of dimensionless wavevectors. The effect of lossy/lossless substrate on near-field radiative heat transfer between a-MoO3 films is investigated, and the near-field radiative heat transfer is discussed when the near-field radiative heat transfer is along different crystallographic axes directions, respectively, and the effects of thickness and the permittivity of the substrate on the near-field radiative heat transfer of the a-MoO3 films are revealed. To address the demand for efficient solar thermal conversion in solar energy applications, research on solar absorbers and nanofluids based on micro- and nanostructured materials has been carried out. The superposition Fabry-Perot resonance theory is applied to the field of solar thermal harvesting, and a design method of solar absorber with multilayer membrane structure is proposed, which reveals the potential mechanism of high absorption performance in different bands and analyzes the influence of the number of cells on the spectral absorption performance. The photothermal conversion properties of solid/hollow nanopillar structures based on four equipartitioned excitation materials are investigated and compared, and the effect of hollow structures on the equipartitioned resonance of localized/propagating surfaces in the nanopillar structures is revealed by investigating the optical properties and resonance modes of solid/hollow nanopillar structures of different materials.

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