Spectral Behaviour of Thick Metal Films Perforated with Nanoholes

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In the absence of a universally accepted model that describes the physics of the anomalous transmission spectrum of an array of nanoholes on optically thick metallic films, an extensive numerical calculation is presented in this paper to relate the scattering modes observed to transmittance spectral behavior. Surface plasmon polariton Bloch Waves (SPP BW), Wood's Anomalies (WA) and Localized Surface Plasmon Resonances (LSPR) at the rim of the nanoholes are investigated based on scattering modes that form the features of the transmission spectrum, i.e. maxima and minima. The impact of each of these optical phenomenons on the transmission process is discussed. The Finite Difference Time Domain (FDTD) method is applied to calculate the transmission intensity from films of gold and silver subjected to variations in geometrical parameters such as film thickness, hole spatial period (i.e. center to center distance of the holes) and hole diameter. Analysis of transmission spectra showed that the cut-off frequency of the array of subwavelength holes is mostly defined by the thickness of the film and the diameter of the holes rather than the periodicity of the structures.