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Geometrical scale invariance of the enhanced transmission spectra of subwavelength hole arrays[1] SINAN SELCUK, KWANGJE WOO, DAVID B. TANNER, ARTHUR F. HEBARD, Department of Physics, University of Florida — There is at present a lack of consensus on the relative strength of contributions from surface plasmon polaritons (SPPs) and composite diffracted evanescent waves (CDEWs) to the mechanism responsible for enhanced transmission through subwavelength hole arrays. For regular square hole arrays with small open area fraction d^2/a^2 (a = lattice constant and d^2 = square hole area), both theories predict that the wavelength $\lambda = \lambda_m$ at which maximum transmission occurs scales linearly with a. The two interpretations diverge however when the open area fraction increases and the distance between two adjacent hole edges decreases. We test these ideas by comparing transmission spectra of sets of arrays where each set has a fixed open area fraction but is scaled to different sizes by changing a. We find in our preliminary data that for a factor of 10 change in a, from 1 μm to 10 μm, the transmission peaks, when plotted as a function of λ/a, collapse onto the same scaling curve. This collapse is independent of hole size d and is in good agreement with SPP theory when the wavelength-dependent refractive indices of the substrates (quartz and ZnSe) are taken into account.

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