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Interferometric Plasmonic Lensing with Nanohole Arrays YU GONG, ALAN JOLY, PATRICK EL-KHOURY, WAYNE HESS, Pacific Northwest National Laboratory, CHEMICAL PHYSICS TEAM — Nonlinear photoemission electron microscopy (PEEM) is used to map propagating surface plasmons launched from lithographically patterned isolated nanoholes and nanohole arrays in gold films. A damped elongated ring-like photoemission beat pattern is observed from individual nanoholes. Strong near field photoemission patterns are observed in the PEEM images, recorded following low angle of incidence irradiation of the plasmonic nanohole arrays with sub-15 fs laser pulses centered at 780 nm. The recorded photoemission patterns are attributed to constructive and destructive interference between propagating surface plasmons launched from the individual nanoholes which comprise the array. By exploiting the wave nature of propagating surface plasmons, we demonstrate how varying the array geometry (hole diameter, pitch, and number of rows/columns) ultimately yields intense localized photoemission patterns. Through a combination of PEEM experiments and finite-difference time-domain simulations, we identify the optimal array geometry for efficient light coupling and interferometric plasmonic lensing. We also describe an exemplary practical application of the nanohole array-based plasmonic lenses, namely, enhanced photoemission from a vertex of a strategically positioned gold triangle.

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