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Propagating and localized surface plasmons in Ag nanostructures

MACIEJ DABROWSKI, YANAN DAI, HRVOJE PETEK, Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, PA 15260 — Plasmonic excitations strongly depend on the size, geometry and dielectric environment of nanoscale metals. Here, we study an epitaxially grown Ag nanostructures on Si(001) and Si(111) surfaces by Low Energy Electron Microscopy/Photoemission Electron Microscopy (LEEM/PEEM). Using the combination of LEEM and broadly tunable femtosecond laser excited multiphoton PEEM we image how single crystalline metallic nanostructures form and how plasmon excitations depend on the particle structure and laser excitation parameters. For Ag pyramids with the dimensions of few hundreds nanometers, dipolar and quadrupolar localized surface plasmons are observed. For Ag wires with several micrometer lengths, both localized and propagating surface plasmons can be excited, depending on the polarization, particle orientation and energy of the excitation. Finally, in larger Ag islands, several micrometers in size, the interference patterns are created by plasmon waves excited at the island edges. In addition to plasmonic response, light diffraction patterns around the Ag nanostrutures are discussed.

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