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Femtosecond microscopy of surface plasmon propagation on a silver film.[1] ATSUSHI KUBO, Department of Physics and Astronomy University of Pittsburgh, PRESTO JST, NIKO PONTIUS, BESSY mbH, HRVOJE PETEK, Department of Physics and Astronomy University of Pittsburgh — By using interferometric time-resolved photoelectron emission microscopy (ITR-PEEM), we investigate the dynamics of surface plasmon polariton (SPP) propagation with 0.33-fs per frame time and 40-nm spatial resolution. 10-fs phase-locked pump-probe pulse pairs with 400-nm center wavelength irradiate a silver film at 65 degree angle from the surface normal to launch a SPP wave from a line defect in the film. We image the propagation of the SPP wave through its interference with the external light field. The interference periodically modulates the total amplitude of the polarization field in silver, and thereby the two-photon photoemission current from the surface. Two-dimensional microscopic maps of the photoemission intensity at pump-probe delay τ_d are recorded by the PEEM. Sequential PEEM images taken with a delay increment step of 0.33-fs record the dynamics of SPP wave packet propagation and dissipation as a movement of the oscillatory interference pattern. The progression speed and the attenuation of the oscillatory pattern are reproduced by a simulation with the known dispersion of the complex SPP wave vector. The SPP imaging experiments demonstrate the possibility of coherent control of plasmon field in metallic nanostructures.

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