Abstract Submitted
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Ultrafast dynamics of surface plasmon polaritons in subwavelength nanohole array on metallic film[1] A.S. KIRAKOSYAN, T.V. SHAHBAZYAN, Jackson State University, M. TONG, Z.V. VARDENY, University of Utah — The ultrafast dynamics of surface plasmon polaritons (SPP) photogenerated on the surfaces of an Al film perforated with 2D subwavelength hole array (∼300 nm lattice constant) was studied by the pump-probe correlation spectroscopy. Following an instantaneous rise at the onset of the impinging pulse, the transient differential transmission exhibits a fast rise with characteristic time constant of ∼300 fs reaching a plateau at ∼2 ps, followed by a slower decay with characteristic time of ∼40 ps. The observed dynamics can be explained by a fast energy transfer in the Al film from the electron gas to the lattice, with subsequent cooling of the Al film by heat transfer to the glass substrate. The fast dynamics is accompanied by a blue shift of the SPP band due to the increase in the Al lattice temperature. The obtained fast lattice temperature rise is caused by the strong electron-phonon interaction in Al, which makes the electron-lattice energy transfer rate comparable to the rate of nonequilibrium electrons thermalization via electron-electron interactions. A theoretical model based on the Boltzmann equation for nonequilibrium electron gas interacting with quasi-equilibrium phonons was developed, and is in good agreement with the data.

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