Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Optical conductivity of granular metals YEN LEE LOH, Purdue University, VIKRAM TRIPATHI, Cambridge University, UK — Arrays of metallic grains, which can be fabricated in a number of ways, exhibit interesting behavior in many properties due to the interplay between tunneling and Coulomb blockade effects. One such property is the AC conductivity, which can be measured using optical reflectivity techniques. We present here a calculation of the AC conductivity of a regular granular array. For this purpose we have found it necessary to generalize the Ambegaokar-Eckern-Schön (AES) model to include polarization fluctuations as well as charge fluctuations. In contrast to the DC conductivity, which is determined by inter-grain charge transfer and obeys an Arrhenius law at low temperature, we show that the AC conductivity is dominated by a resonance peak for intra-grain polarization oscillations, which has a power-law tail at low frequencies. Although the resonance frequency agrees with the classical prediction, the resonance width depends on quantum mechanical tunneling and Coulomb blockade parameters, in addition to intra-grain impurity scattering. This additional damping is due to inelastic cotunneling of polarization fluctuations to neighbouring grains.

Yen Lee Loh
Purdue University

Date submitted: 29 Nov 2005 Electronic form version 1.4