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Electrical Transport and 1/f Noise in Au Nanoparticle Films C. KURDAK, J. KIM, J. J. LUCIDO, A. KUO, L. A. FARINA, X. BAI, Physics Department, M. P ROWE, K. E. PLASS, A. J. MATZGER, Chemistry Department, University of Michigan, Ann Arbor, MI 48109 — We studied the transport properties of Au nanoparticle films deposited on interdigitated electrodes with electrode spacings ranging from 0.1 μm to 1 μm. $I - V$ characteristics are found to be nonlinear and strongly dependent on both the coating and size of the nanoparticles. Current is thermally activated at low bias voltages, exhibits a threshold behavior, and scales as $I \propto (V - V_{th})^{\zeta}$ at low temperatures. To complement dc transport measurements, we have performed noise measurements on some of the films. All the films that were studied exhibit 1/f type noise at low frequencies. The magnitude of the 1/f noise is smaller in devices with a larger device area, indicating that the 1/f noise is caused by intrinsic processes. The noise amplitude is found to be strongly temperature dependent between 40-300 K, with a local peak at around 100 K, and weakly dependent below 40 K. The noise data could not be fit by a single activated process, which would have led to an Arrhenius type temperature dependence. At low temperatures, the normalized noise spectra scaled as $S_I/I^2 \propto (V - V_{th})^{\gamma}$. The relationship between the scaling exponents ζ and γ is consistent with our prediction of $\gamma = 1 - \zeta$.

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