Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

The Classical Size Effect: Impact of Grain Boundaries on Resistivity in Encapsulated Cu Thin Films[1] TIK SUN, BO YAO, ANDREW WARREN, KEVIN COFFEY, University of Central Florida, VINEET KUMAR, KATAYUN BARMAK, Carnegie Mellon University — Surface and grain boundary electron scattering contribute significantly to resistivity as the dimensions of polycrystalline metallic conductors are reduced to, and below, the electron mean free path. A methodology is developed to independently evaluate surface and grain boundary scattering in encapsulated polycrystalline Cu thin films, with thicknesses in the range of 27-165 nm. The film resistivity, measured at both room temperature and at 4K, is compared for samples having different grain sizes (as determined from 400 to 1,500 grains per sample) and film thicknesses. The experimental data is compared to models of surface and grain boundary scattering in thin films. The resistivity contribution from grain boundary scattering is found to be significantly greater than that of surface scattering in Cu thin films which allows a quantitative measurement of the parameters for the Mayadas-Shatzkes model. It is also found that the Ta barrier layer prohibit grain growth which explains the higher resistivities observed in encapsulated Cu samples with Ta barrier layers.

[1]This research is supported by the SRC, Task 1292-008 and the MRSEC under NSF DMR-0520425.

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Date submitted: 03 Dec 2007 Electronic form version 1.4