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Effects of Surface Roughness and Electron-Phonon Interaction on Electron Transport of Ultrathin Epitaxial Copper Films[1] YUKTA TIMALSINA, ANDREW HORNING, ROBERT SPIVEY, KIM LEWIS, GWO-CHING WANG, TOH-MING LU, Center for Materials, Devices & Integrated Systems, and Department of Physics, Applied Physics and Astronomy, Rensselaer Polytechnic Institute — We report effects of surface roughness and electron-phonon interaction on transport properties of electrons in ultrathin epitaxial copper films of thickness ranging from 5 nm to 500 nm grown on Si(100) substrates. The transport of electrons in the film was examined by measuring the temperature dependent resistivity in the temperature range of 5 K to 300 K. We demonstrate that the temperature independent component of resistivity can be described by the root-mean-square-surface roughness and lateral correlation length with no adjustable parameter, using a recent quasi-classical model developed by Chatterjee and Meyerovich [1]. However, the temperature dependent component of the resistivity can be described using the Bloch-Grüneisen formula with a thickness dependent electron-phonon coupling constant and a thickness dependent Debye temperature. We show that the increase of the electron-phonon coupling constant with the decrease of film thickness gives rise to an enhancement of the temperature dependent component of the resistivity.

[1] Chatterjee S and Meyerovich A E 2010 Interference between bulk and boundary scattering in high quality films *Phys. Rev. B* **81** 245409–10

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