

An Investigation of the Weak Localization, Electron-Electron Interaction and the Superconducting Fluctuations in a Weakly Disordered Granular Aluminum Film

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Abstract : We report a detailed study on the transport properties of a 40 nm thick granular aluminum film. As measured by temperature-dependent resistance $R(T)$, a resistance peak is observed before the transition to superconductivity, which indicates that the diffusion channel is subjected to weak localization and electron-electron interaction, and the superconductor channel is subjected to SC fluctuations (SCFs). The zero-magnetic field transport measurement demonstrated that Electron-Electron Interaction (EEI), weak localization, and SCFs are closely related in this granular aluminum film. The characteristic temperature at which SCFs emerge on the sample is determined by measuring the $R(T)$ during cooling. The SCF of the film is studied in terms of the direct contribution of the Aslamazov-Larkin's fluctuation Cooper pair density and the indirect contribution of the Maki-Thomson's quasiparticle pair density. In this sample, the rise in $R(T)$ above the SCF characteristic temperature indicates the WL and/or EEI. Comparative analyses are conducted on how the EEI and WL contribute to the upturn in $R(T)$.

Keywords : fluctuation superconductivity, weak localization, thermal deposition, electron-electron interaction

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