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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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