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CALCULATION BY ELIASHBERG THEORY OF CRITICAL CURRENT AND CRITICAL ELECTRIC FIELD IN THIN SUPERCONDUCTING FILMS

Giovanni Alberto Ummarino1,2, Alessio Zaccone3

[1]Dep. of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, ITALY
[2]Dep. of Semiconductor Quantum Electronics, National Research Nuclear University MEPhI, Moscow Engineering Physics Institute, Kashira Hwy 31, 115409 Moskva, RUSSIA
[3]Dep. of Physics "A. Pontremoli," University of Milan, via Celoria 16, 20133 Milan, ITALY

Supercurrent field-effect transistors realized in thin metallic films hold a great promise for future microelectronic devices. In spite of intense research, a complete quantitative microscopic mechanism by which superconductivity in thin films is suppressed by an external DC electric field is missing. Here, for the case of NbN, we provide a quantitative description of superconductivity based on Eliashberg theory. This calculation is in the dirty limit and provides an estimate of the magnitude of the external electric field needed to suppress superconductivity in thick dirty NbN films of the order of 10^7 V/m, in agreement with experimental observations. We link this critical external electric field with the value of the critical density current and we provide a recipe for reducing the value of the critical electric field.

References

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