Normal reflection at superconductor - normal metal interfaces due to Fermi surface mismatch

E. Tuuli and K. Gloos

Wihuri Physical Laboratory, Department of Physics and Astronomy, University of Turku, Turku, Finland

Electrons can be normal reflected at an interface between two metals because of a dielectric barrier or different Fermi wave vectors. The most simple description uses a one-dimensional free-electron approximation[1] to derive the transmission coefficient $\tau = 1/(1 + Z^2)$ where $Z^2 = Z_b^2 + (1 - r)^2/4r$ with $r = k_{F1}/k_{F2}$ the ratio of the Fermi wave numbers and Z_b the contribution of the dielectric barrier. Andreev reflection allows a direct measurement of Z when one of the metals is a superconductor. We have investigated normal reflection of normal metals in contact with superconducting Nb ($T_c = 9.2\,\mathrm{K}$) and Al ($T_c = 1.2\,\mathrm{K}$). The distribution of Z values of a large number of contacts of a specific metal combination indicates a well-defined onset which we attribute to Fermi surface mismatch. The distribution is broadened possibly due to varying polycrystal orientations of the contacts. It also has a weakly resolved tail at large Z expected for the additional dielectric barrier. Our Andreev-reflection derived transmission coefficients are generally larger than those predicted theoretically[2] or those based on proximity-effect studies of normal-superconductor bi-layers[3].

[1]G. E. Blonder and M. Tinkham, Phys. Rev. B **27**, 112 (1983).
[2]P. X. Xu, K. Xia, M. Zwierzycki, M. Talanana, and P. J. Kelly, Phys. Rev. Lett. **96**, 176602 (2006).
[3]V. N. Kushnir, S. L. Prischepa, C. Cirillo, and C. Attanasio, J. Appl. Phys. **106**, 113917 (2009).