Spin polarized conductance in ferromagnet / insulator / conventional superconductor junctions

I. Shigeta, Y. Tanaka, A. A. Golubov, and M. Hiroi

Department of Physics and Astronomy, Kagoshima University, Kagoshima 890-0065, Japan
Department of Applied Physics, Nagoya University, Nagoya 464-8603, Japan
Faculty of Science and Technology, University of Twente, 7500 AE Enschede, The Netherlands

The modified Blonder-Tinkham-Klapwijk (BTK) theory has been successfully used to describe the current-voltage characteristics of ferromagnet / insulator / conventional superconductor contacts. The spin polarization $P$ of the Andreev reflection measurements for ferromagnetic materials has been normally determined by using the modified BTK theory. However, the modified BTK theory assumes the elementally sum of only two currents of the fully-polarized state and the non-polarized state. Therefore, based on the BTK theory, we here suggest another theoretical model of the spin polarized conductance $\sigma(eV)$ in the system of ferromagnet / insulator / conventional superconductor contacts. We consider the exchange potential $U_{ex}$ of the ferromagnetic materials corresponding to the parameter of the spin polarization. The zero-bias conductance $\sigma(0)$ gradually decreases with the increase of $U_{ex}$ because the Andreev reflection is suppressed at the junction interface of ferromagnet / superconductor contacts in the case of finite values of $U_{ex}$. Finally, we discuss fitting results of $\sigma(eV)$ and $P$ for Heusler alloy/Pb planar junctions with the theoretical model.