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Modeling low-Tc Transition-Edge Sensors Made of Multi-layer Metal Films: Thickness Dependence of Electron Transparency at Interfaces

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Cryogenic neutrinoless double beta decay searches and low mass particle dark matter searches require a Transition-Edge Sensor (TES) with a high energy resolution. An effective way to improve the energy resolution of a TES detector is to use low-Tc TES. The common practice making a low-Tc TES is using the proximity effect, in which the Tc of a superconducting film is reduced with a normal metal film on one side or with two normal metal films on both sides. The resulting Tc of the bilayer or trilayer TES can be understood by solving the Usadel equations with given boundary conditions. But when solving the Usadel equations in the microscopic description, the electron transparency at the interface or the interface resistance is usually assumed to be a constant (independent on the thicknesses of films). In this paper, we will introduce the film thickness dependence of the electron transparency at the interface, and summarize the modeling results of a bilayer and a trilayer TESs in the microscopic description. Utilizing the experimental data from several resources, including the data from our group and the data in literature, we will compare the fit parameters and fit errors using the model described in this work and the model assuming a constant electron transparency at the interface.

Less than 5 years of experience since completion of Ph.D

N

Student (Ph.D., M.Sc. or B.Sc.)

N

Primary authors: Dr DROBIZHEV, Alexey (University of California, Berkeley); Dr SCHMIDT, Benjamin (Lawrence Berkeley National Laboratory); Dr WELLIVER, Bradford (Lawrence Berkeley National Laboratory); FUJIKAWA, Brian (Lawrence Berkeley National Laboratory); LI, C. (UC Berkeley); CHANG, Clarence (Argonne National Lab); Dr KARAPETROV, G (Drexel University); WANG, Gensheng (ANL); BENATO, Giovanni (University of California Berkeley); Dr OUELLET, J.L. (Massachusetts Institute of Technology); ZHANG, Jianjie (ANL); Mr PEARSON, John (Materials Science Division, Argonne National Laboratory); HAFIDI, Kawtar Hafidi (Argonne National Laboratory); Dr MARINI, Laura (University of California, Berkeley); Dr HENNINGS-YEOMANS, Raul (University of California, berkeley); Mr HUANG, Roger (University of California, Berkeley); Mr WAGAARACHCHI, S (University of California, Berkeley); Prof. O'DONNELL, Thomas (Department of Physics, Virginia Tech); Mr POLAKOVIC, Tom (Drexel University); Dr NOVOSAD, Valentine (Materials Science Division,Physics Division, Argonne National Laboratory); SINGH, Vivek (University of California, Berkeley); YEFREMENKO, Volodymyr (Argonne); ARMSTRONG, Whitney (Argonne National Laboratory); KOLOMENSKY, Yury (UC Berkeley/LBNL); MEZIANI, Z.E. (Argonne National Laboratory)

Presenter: WANG, Gensheng (ANL)

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