MRSEC SEMINAR SERIES

"Proximity effects in hybrid superconductor/organic-linker/nanoparticle systems."

While the superconductor surface proximity effect is well understood in layered superconductor/normal-metal junctions, its understanding is quite limited in systems involving nanoparticles (NPs) and molecules. Fundamental important and intriguing questions such as the nature of Andreev reflections in nanoscale metallic particles and molecules, and the interplay between the different energy scales such intricate systems poses, are still open. Even less understood are proximity effects in hybrid superconductor/linker-molecule/nanoparticle systems we study. The complexity and breadth of phenomena we plan to study is not yet fully understood, and even less clear is the PE in systems involving linker-molecules.

In a recent study of such a system, we found experimentally two unique proximity effect - related phenomena, in which T_C and the critical current of a Nb film increased upon chemically linking gold NPs [1,2]. Even more surprising similar effects were measured using magnetic Co NPs [3]. Concomitantly, the tunneling density of states (DOS) in the gold NPs was significantly modified, showing either zero-bias peaks or proximity induced gaps. These unexpected phenomena are not fully understood, and several mechanisms can explain the results.

A deeper understanding could further insight into the in nanostructured systems and charge transfer through organic molecules, an issue relevant to the emerging field of molecular quantum electronics. Other application originates from the proximity effect control; these could be related to Josephson surface junction devices, superconducting memory devices and combing spintronix and superconductivity.

References:
[1] E. Katzir, et al. Appl. Phys. Lett. 98 223306 (2011); [2] E. Katzir, et al. Phys. Rev. Lett. 108, 107004 (2012); [3] E. Katzir, et al. Euro-physics letters 108 37006 (2014).

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