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[Invited] Direct writing of High-TC Josephson Junctions with Focused Helium Ion BEams

Wednesday 12 July 2017 11:00 (30 minutes)

The 1987 discovery of high-TC superconductivity in ceramic materials at temperatures around 90K set off a frenzy of research in the development of high-TC electronics,motivated by the prospects of electronics operating in liquid nitrogen at 77K opposed to 4K liquid helium. Unfortunately, researchers soon discovered that these new materials were much more difficult to process than conventional metal superconductors. High-TC materials are very anisotropic and the superconducting properties vary along the different crystallographic directions which complicates manufacturing of the basic building blocks of superconducting electronics: Josephson junctions. Furthermore, the length scale of superconductivity in high-TC ceramics is very short compared to low-TC metals. Despite these challenges many high-TC Josephson junction manufacturing techniques have emerged over the last three decades but none is able to generate large numbers of junctions with predictable characteristics necessary for large scale circuits. Recently, my group has demonstrated a new scalable nanomanufacturing method of high-TC electronics using the finely focused beam from a helium ion microscope, which has the potential to deliver large numbers of high-quality circuits while at the same time reducing their costs by orders of magnitude. I will present some of the novel characteristics and applications of this new remarkable technology ranging including biomedical sensors for neural imaging and advanced wide bandwidth electrically small antennas.

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