



Contribution ID: 509

Type: Contributed Oral Presentation

Focused Helium Ion Beam Irradiated Josephson Junctions and Arrays

Wednesday 12 July 2017 11:30 (15 minutes)

We have fabricated Josephson junctions and arrays with a focused helium ion beam from Y-Ba-Cu-O, a high temperature superconductor^{. The Josephson junction is the fundamental building block of most superconducting electronics. Normally the size of a junction is chosen to be less than the Josephson penetration depth (λ_{J}) $\sim 4 \mu\text{m}$, a fundamental length scale for superconducting devices, because it ensures that the supercurrent is distributed evenly throughout the junction. For a static current biased Josephson junction or array of junctions, the voltage across the device modulates in a magnetic field. The voltage as a function of magnetic field (V - B) of an ideal Josephson junction goes as $|\sin(B \times A)/(B \times A)|$. Where $B \times A$ is the product of applied magnetic field B and junction area, A . When the length of a junction becomes larger than λ_{J} , the V - B comes more triangular and asymmetric. As a result, this improves the linearity of the Josephson based voltage magnetic field transducing devices. In addition, the skewing of the V - B makes one side of the peak extremely sharp that enhances the sensitivity (dV/dB^*) to detect small fields.}

In our work, we will present the fabrication process and measurement results of Josephson junctions and arrays with widths that range from 1 micron to 30 microns. These devices were fabricated with 30 nm Y-Ba-Cu-O films grown by reactive coevaporation. After patterning the large features and electrodes of the devices with standard photolithography and Ar ion beam etching, the junctions were directly written using a 30 keV focused helium ion microscope with doses of $10^{16} \sim 10^{17}$ ions/cm^{². Our results show that Josephson junctions and arrays have great potential for large dynamic range for advanced magnetic antennas for communications.}

^{^{*}}

Cybart, Shane A., et al. "Nano Josephson superconducting tunnel junctions in YBa₂Cu₃O_{7- δ} directly patterned with a focused helium ion beam." *Nature nanotechnology* 10.7 (2015): 598-602.

Author: ZHOU, Yuchao (University of California, Riverside)

Co-authors: CYBART, Shane (UC Riverside); Dr CHO, Ethan

Presenter: ZHOU, Yuchao (University of California, Riverside)

Session Classification: M3OrD - Focused Session: Cryogenic Microelectronics & Materials I