Monolithic polarization control of THz radiation using Bi-2212 mesa geometrical structures.

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In the past decade, continuous-wave terahertz sources made of high-Tc superconducting $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi-2212) have been extensively studied [1]. Mesa-shaped Bi2212 terahertz sources are compact in size, have broad tunable frequency ranges, and monochromic radiations. In many applications, polarization controls of the terahertz radiation are needed. However, commonly studied Bi2212 sources in the shape of a rectangular mesa are linearly polarized [2]. Circular polarization (CP) is achievable in laboratory-environments by using external optical devices such as quarter-wave plates. Nevertheless, monolithic generation of CP is highly in demand for compact and portable devices.

Polarization control of THz emission from Bi-2212 has been numerically studies in multiple publications [3,4]. In the present study, we demonstrate experimentally, that the polarization can be monolithically controlled in Bi-2212 based sources by using the geometrical structure of the stacked Intrinsic Josephson junctions (IJJs) in a mesa form. The devices discussed here have mesas in the shape of a cylindrical structure with two notches on its sides (Fig. 1(b)), and a square with truncated edges (Fig. 1 (a)). Around 25 K, the polarization state, as represented by the axial ratio (AR), was found to be as low as 0.2 dB with a tunability between circular to elliptical polarization (AR > 3dB). The polarization properties are measured by using a rotating wire-grid polarizer in the emission path between the source and a Si-Bolometer.

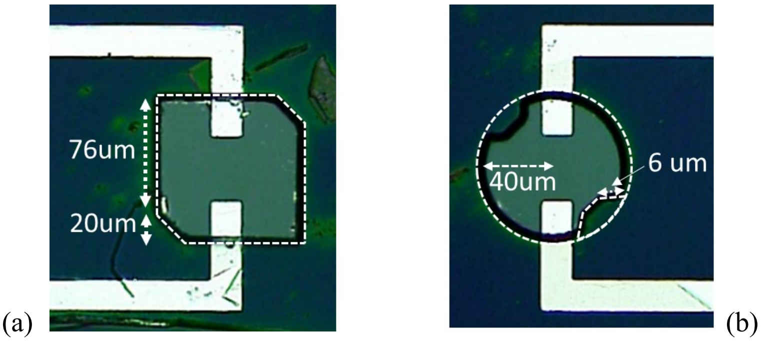

Fig. 1 (a) Truncated edge square mesa. (b) Cylindrical mesa with notched sides.

References:

[1] I. Kakeya and H. Wang, Supercond. Sci. Technol. **29**, 73001 (2016).

[2] L. Ozyuzer, et al, Science **318**, 1291 (2007).

[3] A. Elarabi, Y. Yoshioka, M. Tsujimoto, Y. Nakagawa, and I. Kakeya, Phys. Procedia **81**, 133 (2016).

[4] H. Asai and S. Kawabata, IEEE Trans. Appl. Supercond. **8223**, 1 (2016).