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Reduction of the leakage current for embedded STJ

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Superconducting tunnel junction (STJ) is expected as a next-generation photon detector because of high energy resolution, high counting rate and wide energy range. However, the detection area of single STJ is limited to 0.01 mm^2. One of the solutions is the expansion of the detection area by the array of the STJ. The conventional array format of the STJ also has a problem. Large format arrays will reduce the detection efficiency because of its larger number of the contact wires. To solve this problem, we have proposed an embedded STJ (e-STJ) with through Si via as shown in Fig. 1 (a). The detection efficiency of the e-STJ is not affected by the number of the wires. A simple e-STJ in Fig. 1(b) has shown good I-V characteristic at 4.2 K.
So far, the I-V characteristics of the simple e-STJ showed large leakage current at 0.3 K. In this research, we fabricated a conventional STJ and three types of e-STJ : simple e-STJ and e-STJ where the side surface of the STJ is not in contact with the Si substrate and e-STJ where only the side surface of the base electrode layer is in contact with the Si substrate. Then, the cause of the large leakage current at 0.3 K was investigated. We will present about the fabrication methods and the experimental results.

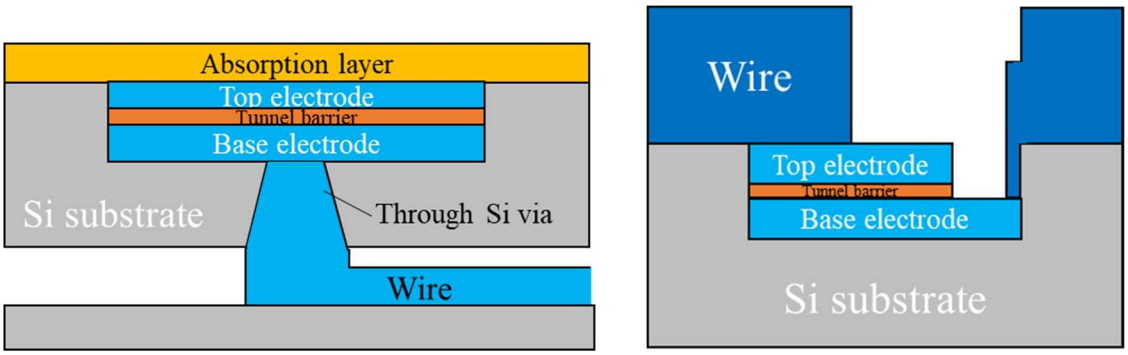

Fig.1 (a) Cross view of e-STJ with through Si via and (b) Cross view of a simple e-STJ

[1] T. Ishizuka et al., The 74th Japan Society of Applied Physics Autumn Meeting, 17p-C10-20 (2013).