

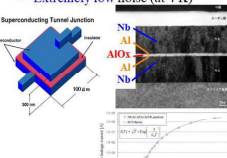
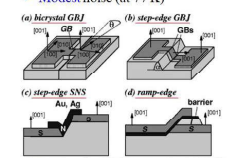


超伝導体が拓く走査プローブ顕微技術の新展開

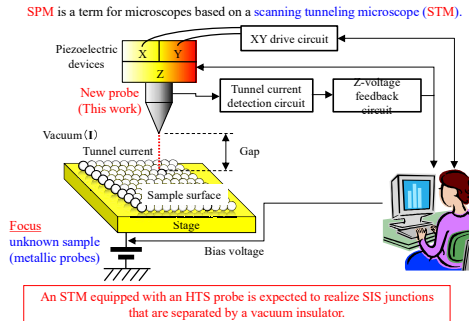
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§ 1 Introduction

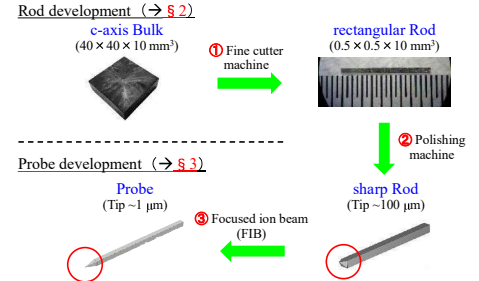
Comparison of superconducting tunnel junctions (STJs)

Low Temp. Supercond. (LTS)	High Temp. Supercond. (HTS)
<ul style="list-style-type: none"> S-I-S junctions are realized. Extremely low noise (at 4 K) 	<ul style="list-style-type: none"> S-I-S junctions are not realized. Modest noise (at 77 K)
	
<ul style="list-style-type: none"> Applications Sensors Generators Quantum computers etc. 	<ul style="list-style-type: none"> Our purpose To maximize the potential of HTS electronics by SIS nano-junctions

Scanning probe microscope (SPM)

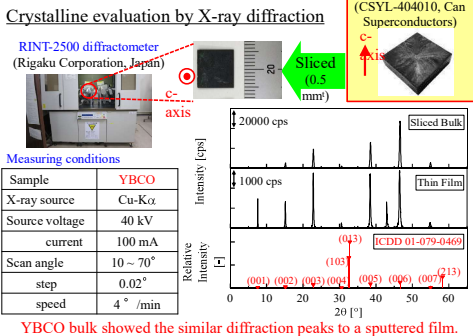


Overview of the fabrication flow

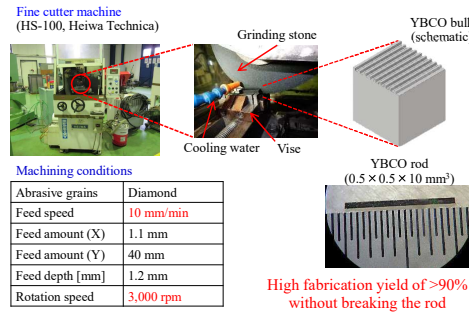


§ 2 Rod development

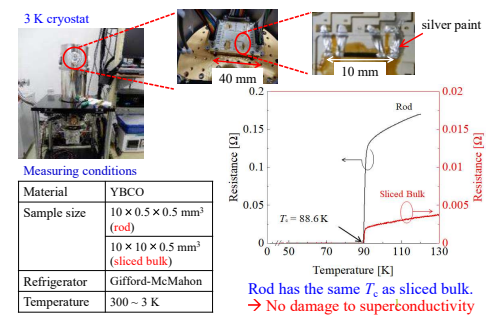
(a) Bulk evaluation



(b) Rod fabrication

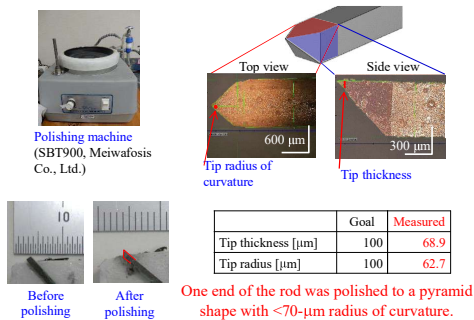


(c) Rod evaluation

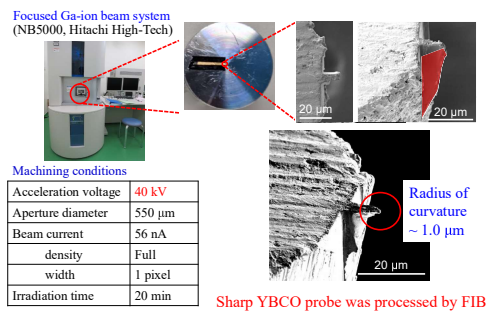


§ 3 Probe development

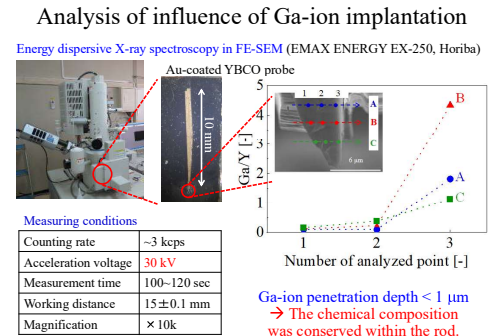
(a) Rod polishing



(b) Probe fabrication

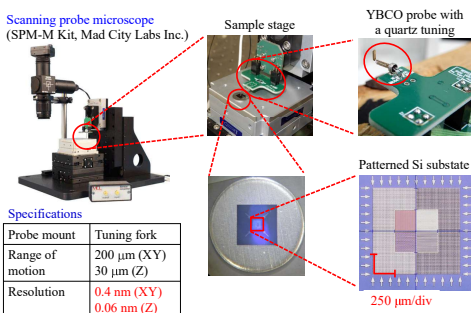


(c) Probe evaluation

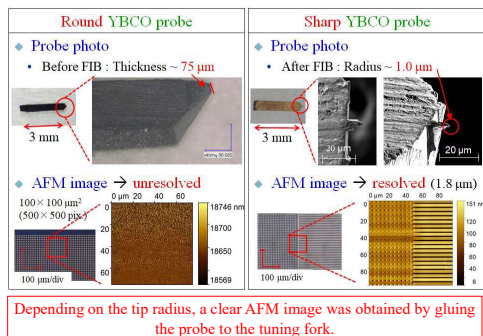


§ 4 Installation to SPM (AFM mode)

Experimental setup



Comparison of AFM images (at 300 K)



§ 5 Summary

- We proposed, fabricated, and evaluated a YBCO probe for realizing SIS junctions.
- Rod development**
 - A c-axis oriented bulk was cut into a rectangular rod using a fine cutter machine.
 - T_c of the rod was ~90 K, which was almost the same as that of the original bulk, indicating no critical damage to superconductivity owing to the cutting.
- Probe development**
 - One end of the rod was ground to a pyramidal shape of ~70 μm radius, and then the apex was further sharpened to ~1 μm using a focused Ga ion beam.
 - The penetration depth of Ga ions from the YBCO surface was <1 μm at 40 kV, suggesting that the chemical composition was conserved inside the rod.
- Installation to SPM (AFM mode)**
 - A YBCO probe was installed in an AFM system, where the probe temperature was set at 300 K at the time. Depending on the tip radius, a clear AFM image was obtained by gluing the probe to a quartz-tuning fork.
- Future works**
 - Optimization of FIB process → Sharper probe tip, reduced AFM damage
 - Construction of 77 K-cooled AFM → AFM imaging in liquid nitrogen
 - Construction of STM → YBCO-based SIS nano-junctions

技術を究め、技術を創る