WBP4-1

Evaluation of Critical Current Superconducting Junction with a Crack by Using FEM

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The junction of the superconducting wires is considered to exhibit a current density distribution different from that of normal superconducting wires, and a stress distribution when receiving a force. Understanding them is essential in designing an applied device. When the junction receives an external force, damage such as cracks may occur. The current density distribution should also be considered when the superconductor wire is defective.

In this study, in order to clarify the electrical and mechanical properties of the junction of superconducting wires, the junction is numerically simulated using the finite element method (FEM) (the simulation tools are JMAG-Designer 17.0 and COMSOL Multiphysics®), and electrical and mechanical properties were evaluated.

We used a 1 μm thick YBCO superconducting film to act as a superconducting wire and jointed two such films together for current density simulation. The analysis was conducted from the left of the model by passing current, calculated using the finite element method, and revealed the current density distribution of the cross section. As shown in Fig. 1, the calculation in the case where there is a crack in the film in the vicinity of the junction was similarly performed. Magnetic field dependence of the critical current density is based on the experimental results of $YBa_2Cu_3O_{7-\delta}$.

Fig. 1 shows the flow direction of the current around the crack. The current density is concentrated on the other side of the crack, which makes the critical current of the superconducting film small. In other words, the maximum current that the superconducting wire can withstand becomes smaller.

Fig. 2 shows the *E-J* characteristics on the superconducting film with various crack width. It is found that the critical current is drastically reduced by increasing the width of crack.

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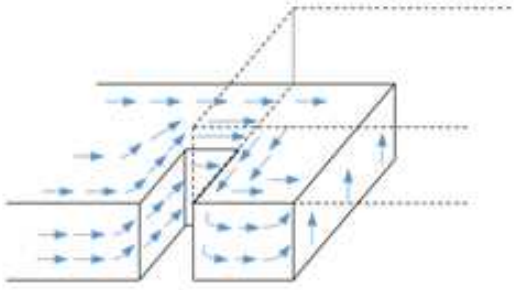

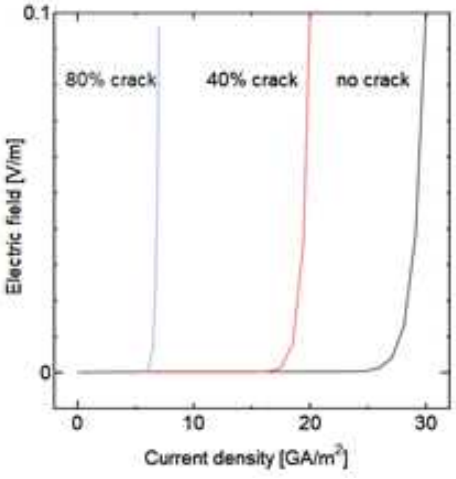

Fig. 1 Superconducting layer with a crack. The arrows indicate the direction of current density.
Fig. 2 *E-J* characteristics on the superconducting film with various crack width.

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