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The influence of local heat generation in a REBaCuO ring bulk with large bore on mechanical fracture during pulsed-field magnetization

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To magnetize superconducting bulks in a more cost-efficient way, pulsed-field magnetization (PFM) is a promising method using a conventional solenoid coil on a laboratory scale. The trapped field, BT, by PFM of a ring-shaped bulk reported to date is around 0.3 T at 60 K, which is quite low compared with that of field-cooled magnetization (FCM), as well as disc-shaped bulks by PFM. The reason for such a low BT is due to large local heat generation due to the rapid movement of flux inside the bulk [1]. Numerical modelling suggested that mechanical fracture is unlikely to occur during PFM because of a relatively small electromagnetic stress within the fracture strength limitation of the bulk material [2]. However, we have observed, experimentally, the fracture of a ring bulk with a large bore during PFM. Thus, it may be required that the thermal stress due to the local heat generation be incorporated in the modelling, which can simulate more realistic conditions in order to clarify the mechanism of the fracture and stress variation during PFM.
In this work, we performed PFM experiments on a GdBaCuO ring bulk (60 mm in O.D., 36 mm in I.D.) for various applied fields, Bapp, and initial temperatures, Ts. As a result, at Bapp = 3.88 T and Ts = 40 K, a flux jump and mechanical fracture occurred in the ring bulk. Numerical simulation of the mechanical stress due only to the local heat generation was performed, in which the width of the localized heated region and the maximum temperature were changed. The possibility of mechanical fracture of the ring bulk due to the local thermal stress during PFM is discussed.
[1] V. S. Korotokov *et al.*, Supercond. Sci. Technol. **30** (2017) 095004
[2] T. Hirano *et al.*, J. Phys. Conf. Series **1559** (2020) 012027

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