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Tensile properties of (Gd,Y,Er)BaCuO superconducting bulk materials fabricated by infiltration growth technique

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REBaCuO, where RE denotes rare-earth elements, superconducting bulk materials are promising for high performance magnets that can trap large magnetic field in compact space. REBaCuO bulk materials are subjected to electromagnetic force and thermal stress in the devices. The electromagnetic force and thermal stress increase as the bulk size and critical current become larger. Thus improvements of the mechanical properties of REBaCuO bulk materials are useful for the development of high-performance devices. REBaCuO bulk materials are single-grain and they are fabricated by melt-processing using a seed crystal. REBaCuO bulk materials fabricated through conventional melt-processing contain pores that cause degradation of mechanical properties. On the other hand, low porosity bulk materials can be fabricated by infiltration growth technique. While conventional melt-processing uses single precursor, infiltration growth technique uses stacked precursor that consists of liquid phase source and solid phase preform. In this study, in order to investigate the mechanical properties of (Gd,Y,Er)BaCuO bulk materials fabricated by infiltration growth technique, tensile tests were carried out for the specimens cut from the bulk materials. After the tensile tests, porosity of the specimens were evaluated and the relationship between the tensile strength and porosity inside the bulk materials was investigated. Tensile strength increases with decreasing the porosity, which is due to the increase of net cross-sectional area and reduction of defects where the stress concentration occurs. Tensile strength of the (Gd,Y,Er)BaCuO bulk materials are comparable to those of other REBaCuO bulk material fabricated by infiltration growth technique and an REBaCuO low porosity bulk material obtained through melt-processing in oxygen atmosphere. Fracture mechanisms of the low porosity bulk materials will be discussed in association with the microstructures.

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