磁場中コロイドプロセスによる REBa₂Cu₃O_y 配向体の作製 Fabrication of grain-oriented REBa₂Cu₃O_y ceramics by colloidal processes in static, rotating and modulated rotating magnetic fields

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REBa₂Cu₃O_y (RE123) superconductors exhibit 90 K-class of critical temperatures and intrinsically high critical current properties. However, due to layered crystal structure and weak link at grain boundaries, bi-axial or tri-axial crystal orientation is required in addition to the formation of densified microstructure for practical use of RE123. Epitaxial growth techniques such as thin film growth and melt-solidification are typical for the formation of bi-axial orientation of RE123. Recently, our group reported that tri-axial magnetic alignment using modulated rotating magnetic fields was accomplished for twin-free RE-Ba-Cu-O compounds, REBa₂Cu₄O₈ and RE₂Ba₄Cu₇O_y, in epoxy resin at room temperature[1,2]. At the current stage, these two compounds are inappropriate for practical use owing to difficulty of the synthesis, and bi- or tri-axial magnetic alignment for RE123 compounds with twin microstructure is desirable with taking inter-grain connection (densified microstructure) into account. In the present study, we focus on colloidal processes under magnetic fields as fabrication methods of grain-oriented RE123 ceramics, and attempted the fabrication of thick films of Y123 and Er123 by electrophoretic deposition (EPD) and sheet-casting under static (SF), rotating(RF), and modulated rotating (MRF) magnetic fields.

Green compacts of RE123 were fabricated by EPD or sheet-casting under various conditions of SF, RF, and MRF using collidal solutions of RE123. For reference, sheet-casted Er124 samples and Er124 powders aligned in epoxy resing under MRFs were also fabricated. Some magnetically grain-aligned samples were sintered for densification and these critical current properties were clarified from these magneto-hysiterisis curves. Figures 1(a) and 1(b) show photo image and (103) pole figure for an Er123 green compact which was sheet-casted under a MRF of 3 T. A rectangular Er123 green compact with 10 mm x 5 mm x 0.5 mm^t was obtained. As can be seen from Fig. 1(b), Er123 grains with twin microstructure were bi-axially oriented in the 3T of MRF. However, the degrees of inplane orientation for the Er123 sample were lower compared with a result of twin-free Er124. Control of twin microstuctures is indispensable for further improvement of the degrees of inplane orientation in RE123. In the present study, results of Y123 and Er123 thick films EPDed in various conditions of SF, RF and MRF will be also shown.

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Fig. 1 Photo image(a) and (103) pole figure(b) for Er123 sheet-casted in 3T of MRF.

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