Contribution ID: **1115** Type: **Invited Oral Presentation**

M2Or3B-01 [Invited]: Flux Pinning by BHO Nanoparticles under Various Strength and Orientations of Magnetic Fields in REBCO Coated Conductors Fabricated by UTOC-TFA-MOD Method

Tuesday, July 23, 2019 3:30 PM (30 minutes)

The TFA-MOD method is a powerful way to fabricate $RE\mathrm{Ba_2Cu_3O_{7-\delta}}$ coated conductors (REBCO-CCs) with high critical current properties with a low fabrication cost. In this study, we focused on the case of $\mathrm{BaHfO_3}$ nanoparticles (BHO-NPs, which have a diameter of < 10 nm) in REBCO-CCs fabricated by the TFA-MOD method with an ultra-thin-once-coating (UTOC) process [1] and carried out critical current density (J_c) measurements under wide temperature (4.2 K < T < T_c) and magnetic field (B < 24 T) conditions with various magnetic-field orientations including the longitudinal-magnetic-field (LMF, $B \parallel J$) configuration and the transverse-magnetic-field (TMF, $B \perp J$) configurations.

In the TMF configurations, REBCO with BHO-NPs possessed larger $J_\mathrm{c}(\theta)$ (θ: angle between $B \perp J, \parallel c$ and $B \perp J, \parallel ab$) compared with those in REBCO without BHO-NPs under most of T and B conditions, indicating that introduction of BHO-NPs is useful way to improve J_c. As a characteristic behavior, REBCO with BHO-NPs showed a broad depression of $J_{\mathrm{c}(\theta)}$ around $B \parallel ab$ at higher T and lower B. We calculated the elementary pinning force based on the model beyond the widely-used model and succeeded in reproducing the depression naturally.

As for the LMF configuration, REBCO with BHO-NPs showed larger $J_\mathrm{c}(B \parallel J)$ than those in REBCO without BHO-NP, suggesting that the flux pinning by BHO-NPs is effective to enhance J_c in the LMF configuration as well as the TMF configurations.
At the conference, we would like to report the more-detailed data described above and to discuss about them.

This work was supported by a matching foundation between AIST and Tohoku Univ., by a research grant from the Japan Power Academy (Specially Promoted research), and by JSPS KAKENHI (18K13783 and 18H05248).
[1] T. Izumi *et al.*, IEEE Trans. Appl. Supercond., **27** (2017) 6601604., K. Nakaoka *et al.*, Supercond. Sci. Technol., **30** (2017) 055008., M. Miura *et al.*, NPG Asia Materials, **9** (2017) e447.
[2] T. Okada *et al.*, IEEE Trans. Appl. Supercond., *in press.*

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Session Classification: M2Or3B - Focus Series B: REBCO Flux Pinning III, High Fields