Contribution ID: **973** Type: **Invited Oral Presentation**

M2Or1B-02 [Invited]: Flux pinning mechanism in angular dependent Jc of REBCO wire with artificial pinning centers

Tuesday, 23 July 2019 10:00 (30 minutes)

REBCO wires with artificial pinning centers (APCs) are known to have extremely high Jc at low temperatures and high magnetic fields. Although understanding of the behavior of Jc when tilting the applied magnetic field from the wire surface is still insufficient, information on the angular dependent Jc is very important in coil design. In current REBCO wires, nanorods are often used for APCs and it is necessary for the effective control of Jc to introduce linearly grown nanorods. But, it is known that increasing the film deposition rate to improve the production speed disrupts the well-controlled growth of the nanorod, and accordingly the Jc decreases. That is, when growing slowly, nanorods grow linearly, but in high-speed film deposition, nanorods tilt or break up, then, various variations occur in angular dependent Jc. In this study, when forming BHO-containing REBCO thin films, two types of samples with different film growth rates were prepared, and the angular dependence Jc of these samples were examined under 4-40 K and 3-25 T. From the measurement results, it is clear that the influence of nanorods is large in the vicinity of B||c, but the influence of intrinsic pinning increases in the vicinity of B||ab in any sample. It was also found that oxygen deficiency affects the size of Jc in either direction. In order to understand the pinning mechanism of these behaviors, pinning energies, self-formation energies and magnetic interactions were modeled from the viewpoint of minimum energy principle, and the pinning arrangement of quantized flux lines was investigated. When Jc was calculated by applying the Lorentz force to this state, it was found that the behaviors of the angular dependent Jc can be explained well. We will report on the modeling of these complex pinning mechanism.

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Session Classification: M2Or1B - Focus Series B: REBCO Flux Pinning I