Spatial variation of local critical current density in long length RE-123 coated conductor

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The high spatial homogeneity of critical current, I_c, in long coated conductor (CC) is one of the most requirements for practical HTS based devices such as magnet and cables. Several manufactures can now supply long length CCs in a peace length of 100's of meters, and a data sheet on the longitudinal I_c variation at 77 K measured by the Hall sensor array method (TapeStar^{TM}) and/or reel-to-reel four probe method are usually attached as a typical characterization together with an I_c value obtained from a short sample. Actually, the value of standard deviation in such I_c variation is often used for a quality index of the long length tape. However, it is not yet fully understood the influence of measurement condition such as spatial resolution, sample length and measurement methods. Furthermore, the origin of local I_c drop and its influence on the in-field current carrying performance have not been clarified. In this study, we have investigated local I_c variation in long length CC tapes with high spatial resolution using reel-to-reel scanning Hall probe microscopy (RTR-SHPM). After characterizing local I_c drop, we have investigated in-field current transport properties using site-specified four probe measurements. Statistical behavior of the I_c variation has also been investigated. Along with the spatial frequency analysis of the I_c variation, we have pointed out that the observable minimum I_c depends on the sample length, and a method to predict the minimum I_c in the infinite tape length has been proposed. Furthermore, the relationship among typical measurement methods including TapeStar^{TM}, reel-to-reel four-probe measurement and RTR-SHPM has been discussed by taking into account the difference of spatial resolution and electric field criterion.

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