

Conditions for efficiency of force free cables

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Introduction: The possibility to increase the current carrying capacity of multilayer cables using the force free configuration is proposed [1]. The force free multilayer cable should have the inner layer in parallel to the axis of the cable and the most outer layer of the cable with angle θ_{\max} between the tape and the axis of the cable. Between inner and outer layers, the distribution of angles is linear from 0° up to θ_{\max} [2]. The longitudinal magnetic field acting on the superconducting tape on this configuration enhances the current carrying capacity of the superconductor [3].

Model: The method of calculating of the current carrying capacity of force free multilayer cable was presented on the conference [4].

Results: The current carrying capacity of the longitudinal and transversal magnetic fields for Fujikura HTS production tape and heavy ion irradiated HTS tape are shown in Fig. 1. Using these dependences, it was calculated the dependences of current carrying capacity of the 7-layers force free cable vs. inclination of outer layer θ_{\max} . These dependences are shown in Fig. 2. Fujikura sample has the configuration of the cable where the current carrying capacity becomes larger than that in case of $\theta_{\max}=0$. It means that it is possible to create the cable where the longitudinal magnetic field effect will be profitable for the superconductor with characteristics of critical current density as shown in Fig. 1.

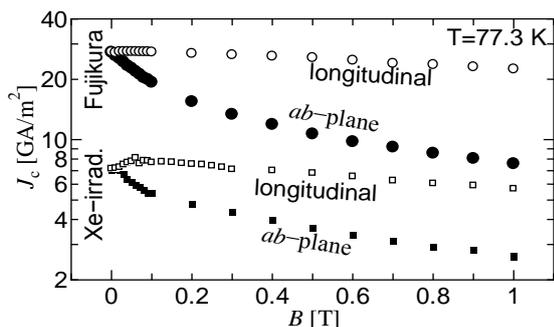


Fig. 1. The dependences of critical current density vs. external magnetic field for HTS tapes.

For heavy ion irradiated sample, the situation is different. Although the increasing of critical current density under longitudinal magnetic field is shown in Fig. 1, the maximum of current carrying capacity is not available as shown in Fig. 2.

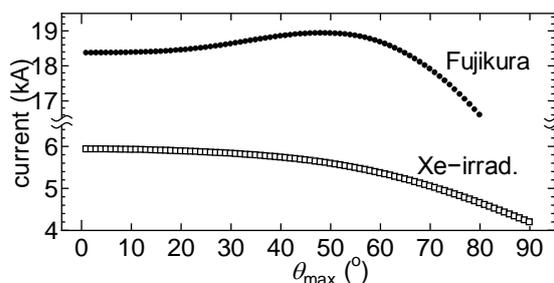


Fig. 2. The dependences of current carrying capacity of 7-layer force free cable calculated from the data on the Fig. 1.

Discussion: This paradox takes place because the force free cable becomes efficient when the difference of current carrying capacity between longitudinal and transverse magnetic field applications is larger than some value. The maximum of critical current for the superconductor in longitudinal magnetic field is not so important like the difference of critical currents between longitudinal and transverse magnetic fields. The conditions of appearing of the maximum of the current carrying capacity in the cable will be considered during the presentation.

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References:

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