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M3Or2B-01 [Invited]: Transport performance and AC loss of superconducting cables comprised of exfoliated YBCO filaments

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The second generation (2G) coated conductors are considered for applications at relatively high, 20 –30 K temperature, which can be achieved with an inexpensive single-stage cryocooler. Electromagnetic AC losses in 2G coils account a significant fraction of the total loss budget. It is well known that the AC loss is proportional to the superconductor filament width. However, reducing the filament width in 2G conductors is challenging due to a very strong sensitivity of the superconducting properties of YBCO to microscopic defects. As the filament width is reduced, probability of a current-blocking defect increases.

The proposed solution is a cable comprised of a stack of exfoliated YBCO filaments. The filaments are manufactured by separating the YBCO layer from the insulating substrate from the YBCO layer. We show that by stacking the filaments we can potentially realize strong current sharing and short, < 1 mm, current transfer length. Magnetization loss of 2 mm 8-filament cable coupons was measured at 77 K in magnetic field up to 0.6 Tesla by a calorimetric method. The frequency dependence of the loss suggests a negligible contribution of coupling currents. The AC loss results are corroborated by measurements of the magnetic hysteresis in small, 8 cm diameter, coils wound from the cable.

Finally, we presented results of the mini-coil tests at 25 K in conduction cooled mode. In the conduction-cooled mode thermal gradients inside the winding greatly affect the flux behavior. The temperature gradients generate non-uniformity of trapped magnetic flux that affect both magnetization loss and the field quality. This is because a small variation of the winding temperature results in a large change of the local magnetization.

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