SMALL COILS MADE WITH SECOND GENERATION HTS WIRE TESTED IN HIGH MAGNETIC FIELDS

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Introduction

For the production of so-called Second Generation (2G) HTS conductor American Superconductor (AMSC) uses a low cost combination of deformation-textured NiW substrates (RABiTS™) with an epitaxial oxide buffer layer and a solution-based YBCO layer [1-3]. The high field properties at 4.2 K make the 2G conductor interesting for high field NMR, and for this reason small coils are tested on a regular basis at 4.2 K and fields between 10-25 Tesla.

Experimental

For the manufacture of the 2G HTS conductor a 75 µm thick, 10 mm wide RABiTS™-type Ni-5 at% W substrate was used with $\Delta\Phi$ = 6.0-6.5º FWHM. It was coated with a 75/75/75 nm Y_2O_3/YSZ/CeO_2 buffer. A metal-organic deposition (MOD) approach [4, 5] was used for the deposition of the 0.8 µm thick YBCO layer. The precursor was decomposed and then reacted to form epitaxial YBCO. A sputtered 3 µm Ag layer sealed the YBCO layer and allowed soldering of a copper foil for electrical and mechanical stability. A number of coils were wound around a G10 mandrel using 1.2 m of 10 mm wide copper-stabilized 2G conductor. The 2G conductor was co-wrapped with 10 mm wide epoxy-saturated fiberglass cloth. The voltage criterion at 4.2 K was 0.1 micro-volt/cm. Short samples were secured to G10 blocks and measured in a parallel and perpendicular orientation to the field. The voltage criterion for I_c was 1 micro-volt/cm.

Results and Discussion

At 77 K two coils showed engineering (overall) critical currents J_e of 86 and 90 A/mm^2. The small coils generated around 50 mT at 77 K. At 4.2 K and 20 T J_e of the two coils (0.1 µV/cm) was 320 and 340 A/mm^2. Above 21 T J_e showed a drop, resulting in 200 A/mm^2 at 25 T. The drop was most likely associated to He gas bubble formation [6], and the 200A/mm^2 at 25 T is probably a lower limit. The 2G sample that was used for short sample testing at perpendicular and parallel fields measured 228 A (77 K, SF), corresponding to J_e= 130 A/mm^2. At 4.2 K and 20 T J_e measured 80 A/mm^2 while in the parallel orientation J_e was 390 A/mm^2, corresponding to a 4.85:1 ratio for the parallel and perpendicular field orientation.

Conclusions

Second Generation HTS conductors are made in increasingly longer length and with critical currents exceeding 250 A (77 K, SF, 10 m lengths). At 4.2 K small coils demonstrated J_e of 200 A/m m^2 at 25T. In short samples a J_c ratio of 4.85:1 was measured for parallel and perpendicular field orientations at 4.2 K and 20 T. Results of the high field measurements were presented at the 2004 Applied Superconductivity Conference in Jacksonville FL [7, 8].

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