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M1Po2B-05 [35]: Magneto-Optical, electromagnetic and SEM study of slitting edge damage in 2G HTS tapes

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High quality 2G HTS tapes are desired for power applications, cables, and high field magnets. The original tape is fabricated in 12-40 mm widths, but most magnets and many cables require narrower tapes made by slitting the original tape. There are many advantages of narrow tapes: reduced magnetization loss, improved field quality, faster ramp time, reduced cryogen loss, and the opportunity to tailor the operating current and magnetization loss. 2G HTS tape manufacturers use mechanical slitting of tapes into several, typically 4 mm wide strips. However, mechanical slitting damages the ReBCO layer, producing a non-superconducting band along the slit edge. Novel slicing methods are clearly needed for narrower sub-mm filaments. Here we describe the latest advances in laser slitting to evaluate the slicing damage to the SuperOx standard production 2G HTS tapes. In this study, 4 mm wide strips were slit from 12 mm wide wires using (1) an Avesta TETA laser, operating at 1030 nm and 8 W power and (2) a standard mechanical slitting machine. The tape samples were based on a 60-micron thick Hastelloy substrate, with IBAD-MgO buffer layer and PLD-GdBCO HTS layer, with I_c at 77 K ranging from 130 to 190 A. Here we compare lengthwise I_c and slitting damage using magneto-optical, continuous transport and SEM methods. We found that laser slitting introduces significantly less edge damage than mechanical slitting and thus produces smaller short-length I_c variations. A mechanical slit reduces the effective conductor width by 400-500 μm, while the laser-cut damage less than 50 μm of the edge. Continuous wave operation lasers overheat the edge and create more damage than fiber pulse lasers.
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