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Effect of different bending diameters on the current-carrying capacity of iron-based superconducting tapes

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The iron-based superconductor (IBS) is a good candidate for high field magnet applications. The bending effect and properties of IBS tapes were systematically investigated in this work. The bent Ba1-xKxFe2As2 (Ba122/Ag/AgSn) 7-filamentary tapes with different bending diameters (D=10, 15, 20, 25, 30 mm) were prepared by wind-and-react method. A special mechanical structure was used to prevent the heat-treated IBS tapes from being damaged during joint soldering. The critical current (Ic) performances of all the bent samples have been tested at 4.2 K and 10 T. When the bending diameter is smaller than 30 mm, the transport Ic of bent IBS tapes decreases with smaller bending diameters. The average ratio of Ic (bent tape) and Ic (straight tape) was also calculated. Compared with the ratio value of 92.6% for D30 tapes, the ratio value for D10 tapes is 63%, which should be related to the cracks observed in the Ba122 superconducting cores. The Optical Microscope Images (OMI) show a lot of cracks that appear regularly in part of the superconducting cores under tensile stress, especially in D10 bent IBS tapes. In contrast, almost no cracks are seen in the superconducting cores subjected to compressive stress. The stress distributions in the bent tapes during the bending and annealing processes were simulated using the software. The most possible formation mechanism of cracks will also be discussed in detail.
Keywords: Iron-based superconductor, bent tape, critical current, stress, cracks

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