

High Performance 2G wires: From R&D to Pilot-scale Manufacturing

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Abstract—Tremendous progress has been accomplished in 2008 in key metrics of YBa₂Cu₃O_x (YBCO) second-generation (2G) HTS wires at SuperPower. Using improved precursor chemistry in our Metal Organic Chemical Vapor Deposition (MOCVD) process, critical currents (I_c) as high as 813 A/cm were reached over meter-long lengths, representing the highest reported I_c in meter long 2G HTS. By use of Zr doping of (Gd,Y)Ba₂Cu₃O_x, strong enhancements were achieved in in-field performance over a wide angular range. A I_c of 229 A/cm was achieved at 77 K and 1 T perpendicular to the wire which is about a factor of 2.5 times better than that of standard MOCVD-derived films. At 65 K and 3 T, a I_c of 340 A/cm was demonstrated perpendicular to the wire. Kilometer lengths of 2G HTS have been demonstrated for the first time. Over 35 tapes 1,000 to 1,500 m in length with a complete 5-layer buffer stack have been routinely produced in our pilot-scale manufacturing facilities. An excellent in-plane texture of 6 to 7 degrees with a uniformity of about 2% was reproducibly achieved in the kilometer-long fully-buffered tapes. Using these high-quality buffers, the longest 2G wire length to date of 1,311 m was produced with a minimum I_c of 153 A/cm corresponding to a I_c × length value of 200,580 m. Also, an 1,030 m long complete 2G HTS wire has been demonstrated with a minimum I_c of 227 A/cm corresponding to a record I_c length value of 233,810 A-m. Further, a 630 m long segment of the wire sustained a minimum I_c of 302 A/cm, the longest 2G wire reported to date with a I_c over 300 A/cm. Also, a I_c of 337 A/cm was achieved over a 540 m long segment. All these values represent a 2-to-3-fold improvement in length and I_c of 2G wires compared to our achievements in 2007. In 2008, a 30 m long 2G cable made with nearly 10,000 m of 2G wire previously delivered by SuperPower was successfully installed and energized in the grid of National Grid in downtown Albany, marking the world's first of 2G HTS device in the power grid.

Index Terms—second-generation HTS, IBAD, MOCVD, cable, long length, critical current, BZO, Zr

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