Tutorial

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Superconductor for Electric Power Application

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Since the discovery of HTSC, many researches have been conducted to utilize this amazing material for fabricating high efficiency electric power devices such as transmission cable, transformer, motor, fault current limiter and superconducting magnet for magnetic separator, MRI/NMR and laboratory research magnet. In order to use HTSC for electric power devices, long-length of HTSC wire/tape should be provided. But the brittle nature of oxide superconductor had prevented the wide use of these materials for power applications in spite that superconducting devices will bring huge benefits to electric industries. Power-in-tube(PIT) method has been successfully developed for the fabrication of Ag/BSCCO superconducting tape with high performance. Nowadays km-length Ag/BSCCO tape is available in market and many power devices have been demonstrated. But the use of silver as a sheath material and the sharp decrease of transport critical current in magnetic field limit further growth of the superconducting device market. The findings of IBAD and RABiTS techniques that utilize the epitaxial growth nature of YBCO thin film on the textured metal substrate triggered the research and development of the 2^{nd} generation oxide superconducting tape, so called coated conductor. R&D has been focused on the improvement of current carrying capacity and mass production techniques of coated conductor for last 10 years. High performance coated conductors in long-length have been demonstrated by several organizations; ISTEC, Fujikura, SuperPower, American Superconductors, Theva. Currently, coated conductor meets most of all the requirements for power device applications and Fujikura and ISTEC reported ~20,000 A-m(I_C x length) with a I_c of 100A and 200A, respectively. But there are still more way to go for commercialization. Key issues such as production cost and production speed should be solved for wide application of coated conductor on power devices. Technically, coated conductor and Ag/BSCCO HTS tape have a limitation of their use for MRI, NMR and magnetic separator magnets which need persistent mode operation. Very recently, KPU suggested new ideas for the design and construction of permanent mode magnet using coated conductor as well as the transposition technique of coated conductor for ac applications. Regarding to the deposition of YBCO film, KPU also developed several techniques such as new MOD precursor, non-stoichiometric coating solution, CVD technique using inorganic precursors.