INVITED

IN I-2

Overview of Japanese National Project on R&D of Coated Conductors

Yuh Shiohara

Deputy Director General, Concurrent Division Director,
Division of Superconducting Tapes & Wires,
Superconductivity Research Laboratory (SRL),
International Superconductivity Technology Center (ISTEC),
10-13, Shinonome 1-chome, Koto-ku, Tokyo, 135-0062 JAPAN

Coated conductors using RE-Ba-Cu-O (RE : rare earth elements) system superconductors have been expected to be used in many electric power applications since it has a high critical current density at the liquid nitrogen temperature even under high magnetic fields. Lots of efforts have been made on development of processing for a long coated conductor with high superconducting performance. In Japan, the 5-years national project for development of coated conductor processing was started at FY2003 and was scheduled until the end of FY2007. The expected goals in this project are; 500m long tapes with high I_c values of 300A/cm-w (@77K, s.f.) and 30A/cm-w (@77K,3T) at 5m/h as the production rate etc. The progress in the recent years is remarkable such as the long tapes over 100m in length with the high I_c values of over 100A/cm-w, including the champion data of the Ic x L product (Ic=245A/cm-w, L=212.6m, IcxL>52,000Am) for the tape fabricated by the IBAD & PLD processes. In this process, application of a CeO2 cap layer deposition by PLD on a GZO-IBAD buffered metal substrate resulted in higher in-plane grain alignment for the buffer layer deposition at much higher fabrication rates. For YBCO deposition, higher production rates for long tapes have been realized by increasing the deposition area by means of the Multi-Plume & Multi-Turn process. Higher Jc(Ic)-B performance has been attained by introduction of non-superconducting phase (BZO) crystals into the coated conductors. The so-called bamboo structure of the BZO rod like structure enhances the Ic values under the external magnetic fields. The Ic value of about 40A/cm-w at 77K, 3T (B//c-axis) was achieved. The long tapes were successfully realized by not only one institution but several ones by means of different processes including TFA-MOD and MOCVD processes. In the case of TFA-MOD process, both Reel-to-Reel and batch furnace systems have been investigated aiming at realization of future low cost processes. The mechanisms of microstructure evolution, especially for higher Ic values by thickening the YBCO layer, were found to be different between PLD and MOD processes, which are mainly due to difference in crystal growth mechanisms, namely surface migration dominant growth for PLD and influence of volumetric diffusion in the precursor for MOD.

Coated conductors have been expected to apply post treatments easily for reduction of AC losses due to its layered architecture in comparison with PIT-BSCCO tapes. A laser scribing process has been applied for the coated conductors to obtain striated structures (multi-filamentation), and the results indicate significant ac-loss reduction successfully as expected.

Additionally, a solenoid type and a series of pancake coils for magnet /motors applications and a power cable using YBCO conductors have been already demonstrated as one of the preliminary results for applications. For the future plans of coated conductor applications, R&D of the following power devices using coated conductors as well as of Cryo-cooler have been started; (1) Power Cable, (2) Transformer, (3) Motor, (4) Fault current limiter.

In this presentation, above mentioned process developments and future prospects for applications of coated conductors will be reviewed.

This work was supported by the New Energy and Industrial Technology Development Organization (NEDO) as Collaborative Research and Development of Fundamental Technologies for Superconductivity Applications