Title:

Recent development and application of superconductivity technologies

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Abstract:
The discovery of ceramic-based high temperature superconductors (HTS) during the 1980's opened the possibility of applying this technology to electric power devices such as power transmission cable, SMES, high magnetic field magnet, SQUID, motor and magnetic levitation trains etc. The HTS has the ability to achieve the superconducting state at temperatures of liquid nitrogen (around 77K), rather than the liquid helium required by the low temperature superconductors (LTS, around 4K). Many high-temperature superconducting materials were discovered since then, Sumitomo Electric Industries (SEI) has been focusing on two materials, bismuth superconductor and rare-earth superconductor, as the promising candidates for practical application. SEI is striving toward development of wires and other products of bismuth (Bi) and rare-earth superconductors.
HTS material Composed of Bi, Sr, Ca, Cu, and O with composition ratio of 2:2:2:3 is called Bi2223 superconductor. It has high critical temperature of 110 K and has been given much attention as a material for practical use since its discovery. By use of Bi2223 tape, for instance, a 100m 66kV/1kA/114MVA HTS cable system was developed in collaboration with Tokyo Electric Company and 1 year long duration test conducted in CRIEPI test site from July, 2001 to verify the system practicability for the real power system equipment.
The HTS cable system is expected to transmit large electric power with a compact size because of its high transport current density. Retrofitting innovative HTS cables in existing ducts is expected to effect not only cost-efficient, but also space-efficient as well.
During each test term, the system shows no change in its properties as expected and by the end of June 2002, all scheduled tests completed successfully.
In addition to development of Bi2223 and its application, rare-earth HTS material composed of Re (rare earth), Ba, Cu and O has been also investigated for the 2nd generation HTS wire. Rare earth includes Y, Nd, Sm, and Ho. The HTS wire use of rare-earth material is able to synthesize the superconductors close to monocrystals by chemical vapor deposition method, and have superior characteristics under critical current density and high magnetic field than that of Bi2223.
Our achievements for both their types of HTS wires and representative application of the HTS cable system have been introduced in this paper.