BMO-Doped REBCO Coated Conductor Development for Field Magnets by Using Hot-wall PLD Process

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Abstract – **REBCO coated conductors by IBAD/PLD process are suitable for varied field coil applications to have excellent and uniform in-field J_c properties and robust mechanical strain strength. Many prototype magnets were wound by using commercial wires and a practical application has achieved as the inner coils for high-field NMR systems of 1.2 GHz class. Such kind of magnetic resonance application strongly requires good I_c uniformity in long piece length and reduction of joint numbers which can affect resolution of the signal.**

The quality of wires has been improved as J_c performance and uniformity, piece length, mechanical reliability as delamination strength, etc. mainly by stabilization of process windows for REBCO film deposition using hot-wall type PLD apparatuses which realized homogeneous growth conditions for REBCO by furnace-like substrate heating. RE elements of Gd or Eu had chosen for wider windows for J_c uniformity of thick REBCO films in wide temperature range.

Under the NEDO program "Project to Promote Commercialization of High-Temperature Superconductivity Technology (2016-2020)," a liquid helium free compact 3-T class whole-body MRI magnet was designed as driving mode operation where the wire specifications of J_e ~ 400A/mm^2 at 30K, 7T. We concentrated on optimization of growth conditions for BMO-doped REBCO wires and found a high-growth rate deposition conditions of several 10s nm/sec with a scattered short length BMO nano-rod structure and a random pinning like scaling behavior for the pinning forces in wide temperature range. In-field J_c properties of ~2-times bigger than non-doped ones were obtained in lower temperature below 40 K, without spoiling process throughput. Mechanical reliability was also evaluated including various fatigue analysis for anisotropic structure of REBCO wires.

A part of this talk includes results obtained from the project consigned or subsidized by the New Energy and Industrial Technology Development Organization (NEDO).

Keywords (Index Terms) – **Hot-wall PLD, BMO nanorod, artificial pinning centers, coated conductor.**

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