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Sat-Af-Spe1-05: [Invited] REBCO Rutherford-Type Cables (FReTC) for high-current and high-field applications

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Rare Earth-Barium-Copper-Oxide (REBCO) High-Temperature superconductor (HTS) exhibits high-current performance in high magnetic fields. Various cabling methods for REBCO tapes have been developed, including Roebel Assembled Coated Conductor (RACC), Stacked Tapes Assembled in Rigid Structure (STARS), Conductor-On-Round Core (CORC®), Twisted Stacked-Tape Cable (TSTC), and a few other alternatives.
We recently developed a Rutherford-type cable for flat REBCO tapes [1]-[3]. Rutherford-type cables have previously been used for low-temperature superconducting and BSCCO-2212 round wires. In addition, high-current Rutherford-type cables based on RACC and TSTC cabling have been fabricated for flat REBCO tapes. However, these REBCO Rutherford-type cables were fabricated by sub-cables composed of Roebel RACC or round-sheathed stacked tape conductors. Therefore, they result in low engineering current density and require extra fabrication steps.
Our Rutherford-type cable, called FReTC, can be directly fabricated onto a thin, flat, round-edge former by winding REBCO tapes from the manufacturer's tape spools. This cabling method allows the fabrication of a full-size conductor, such as a 40 kA-level cable, in a single process.
FReTC has various advantages over other HTS cabling methods, resulting from the Rutherford-type structure of the flat tape superconductors. It has a robust cable structure with a flat core former. FReTC provides better characteristics against transverse electromagnetic forces than other REBCO cables, especially for high electromechanical load applications.
The superconducting tapes in a FReTC are symmetrically wound in parallel. Therefore, the tape inductances are nearly uniformly distributed among the tapes better than other cabling options. Consequently, a uniform current distribution is anticipated. FReTC especially provides an excellent cabling method for narrow-width tapes, which is suitable for AC ramp-field and pulse-field applications. Other advantages are cable design flexibility, excellent tape usage, and cost-effective fabrication.
Therefore, FReTC will be suitable for various applications, especially for high electromechanical load applications, AC pulsed field magnets such as fusion CS magnets, and also industrial motors and generators, accelerator machines, and power transmission cables.
We will present electromechanical characteristics of REBCO FReTC conductors for high-current and high-field applications, including single-process full-size cable fabrication methods, which we are building at MIT PSFC.

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References:

1. M. Takayasu, "Width-bending characteristic of REBCO HTS tape and flat-tape Rutherford-type cabling," Supercond. Sci. Technol., 34, 125020 (13pp), 2021, https://doi.org/10.1088/1361-6668/ac30eb.
2. M. Takayasu, "Rutherford-Type Cabling for REBCO Fine-Filament Tapes,"IEEE Trans. Appl. Superconduct., 34, no. 5, pp. 1-5, 6601505, August 2024, https://doi.org/10.1109/TASC.2024.3364138.
3. M. Takayasu, L. Chiesa, C. Bird, P. Moore, and V. Solovyov, "Bending characteristics of REBCO Rutherford-type cable (FReTC),"ASC 2024, IEEE Trans. Appl. Superconduct, 2025, https://doi.org /10.1109/TASC.2025.3527943.

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