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Electrical and Thermal Contact Resistance in ReBCO Stacks and Cables with Modified Surfaces

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In this work we performed a series of measurements investigating both electrical and thermal contact resistance of YBCO stacks and cables for various surface preparation conditions. We explored the transverse resistance for sets of REBCO tape stacks, measured in a “through-the-stack” configuration. We also explored the ICR of YBCO cables under selected conditions. We analyzed these direct measurements to examine the contributions of the tape surfaces vs the internal tape contributions, and quantified ICR in terms of a contact area independent parameter a contact efficiency, η , defined as $\eta = Rc \cdot Ac$ (the contact resistance * contact area). Measurements were made from 4.2 K to 77 K using a standard 4-point technique. We explored two different ICR modification approaches. In the first, various ten-layer tape stacks were heat treated at 200 °C in an Ar-O₂ environment for 30 min. Before the start of the HT, applied pressures ranging from 0 to 15 MPa were applied by a mechanical constraint. During the HT the constraint remained fixed, which allowed some relaxation and pressure reduction. Constraint was retained until after ICR measurement. These measurements were also applied to round conductor on core YBCO cables with uniaxial applied pressure. In a second approach to surface modification, the individual tapes were electroplated with Ni and, alternatively, Cr before being assembled into a ten stack. ICR was measured for P up to 70 MPa. Mechanical modulus was also measured for both tape stacks and cables, and are reported. A final method was to apply epoxy with nickel filling in between the YBCO tapes, after which the tape stack was compressed under different pressures for curing, and subsequently measured for ICR. Results showed that the surface contact efficiency were modified significantly by these processes.

Primary authors: XUE, Shengchen (OSU); SUMPTION, Mike (The Ohio State University); MAJOROS, Milan (The Ohio State University); Dr COLLINGS, Edward (The Ohio State University)

Presenter: XUE, Shengchen (OSU)

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