HIGH-TEMPERATURE SUPERCONDUCTOR WIRES
Research & Development

Researchers in the Metals and Ceramics (M&C) Division at the Oak Ridge National Laboratory have found a new way to lay down a foundation to form a new high-temperature superconducting (HTS) wire. The new wire can carry 710 times more current per unit area than conventional copper wire -- without energy-wasting resistance due to the unique combination of specifically textured, buffer layers that maintain the texture and deposited film. To develop these HTS wires, researchers in M&C created a Rolling-Assisted Biaxial Textured Substrates (RABiTS) process. The three main steps of the RABiTS process are: biaxially textured metal fabrication, buffer layer deposition, and superconductor deposition. The first step of RABiTS is to produce the proper foundation prepared from nickel ingots by the use of rolling-heating treatment. Next, an E-beam evaporation system was created to produce thin buffer layers of palladium, cerium oxide, and yttria-stabilized zirconia on the foundation. Finally, a pulsed-laser deposition system was created to deposit high-temperature superconductor yttrium-barium-copper-oxide (YBCO) on the conditioned surface to complete the HTS structure. These three step of RABiTS are the key to the entire HTS structure because nickel and copper atoms tend to trade places, making nickel and YBCO incompatible, the buffer layers provide a chemical barrier between the nickel and the superconductor while maintaining the texture. The major focus of the summer research project is on the ability to characterize HTS wires. To characterize an HTS wire, a researcher must be able to measure the critical current, Ic, and transition temperature, Tc, of superconducting tapes. With the unique design of long length Ic and Tc systems created in M&C, a researcher is able to make these characterizations. To conduct these measurements, researchers have developed a silver sputtering machine that allows users to coat samples of HTS tapes with silver, which will allow the Ic and Tc systems to give an electromagnetic property characterization of a specific HTS sample. This ability is very important in the development and designing process of long-length HTS wires.

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