Superconducting Wires Enabled by Nanodots wins Nano50™ Award

HTS Wires Enabled via 3D Self-Assembly of Insulating Nanodots

Background

- For most large-scale applications of high-temperature superconducting (HTS) materials to be realized, fabrication of flexible wires capable of carrying large supercurrents in the presence of high magnetic fields is required. The ideal microstructure of the necessary superconductor includes nanoscale columns of non-superconducting material embedded within the superconductor. Such a microstructure is possible to achieve by irradiating a crystal of the superconductor with heavy ions. However, such a process cannot be used for long superconducting tapes. Hence, for about two decades, an alternate scalable route to achieve this ideal microstructure of the superconductor has been sought.

The Project

- In-situ, co-deposition of yttrium, barium, copper, and oxygen (YBCO) and barium zirconate (BZO) were deposited epitaxial on a single crystal-like substrate.
- Upon deposition, the BZO phase separates from the YBCO and forms a three-dimensional network of insulating columns of nanodots within the superconductor.

Results

- The columnar defects comprised of BZO nanodots are as effective as pining the magnetic flux as those created by heavy-ion irradiation.
- The superconducting properties in the temperature regime of 55-65^{o}K, and in applied magnetic fields of 3-5T, are the best reported to date for such a superconducting material .
- The technology meets performance requirements for most large-scale applications of HTS, including underground transmission cables, military applications and large-scale motors and generators.

Highlights

- US Patent application (Inventors Amit Goyal and Sukill Kang) filed.
- Publication in Science and other journals.
- Awarded the Nano 50™ Award from Nanotech Briefs® Magazine for technology.

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