Technical University of Denmark

SUPERCONDUCTIVITY

- LOSSLESS TRANSPORT OF ELECTRICITY

DTU Energy
Department of Energy Conversion and Storage

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The electrical resistance of a superconductor vanishes when it is cooled down below its critical temperature. This feature makes superconductors interesting for many applications, including power cables and high field magnets. Cables made of classical materials such as copper suffer not only from power dissipation and heat losses, but also from a significantly lower current density. As a consequence, much larger currents can be transferred in superconducting wires with a comparable diameter.

Traditional superconductors have to be cooled with liquid helium, which is expensive and costly in energy. However, high-temperature superconductors can be maintained under operational conditions with liquid nitrogen, which is much cheaper. In addition, recent progress in cryogen-free cooling technology makes it possible to use operating temperatures as low as 20 K (-253 °C) when necessary.

The main technological disadvantage of high-temperature superconductors is that they are made of brittle ceramic materials, which precludes the use of cheap wire manufacturing processes such as drawing. For this reason it is necessary to develop and optimize a solution involving a metallic stabilizer.

The Department of Energy Conversion and Storage has worked in the field of superconducting wires since 1995. The focus is on materials like MgB_2, $YBa_2Cu_3O_7$ and bismuth-based cuprates, which do not require liquid helium for cooling. Our group covers all the key aspects of wire manufacture and characterization relevant for large-scale production, including processes such as powder-in-tube and bi-axially textured multilayer structure deposition by chemical solution. An important development goal is cost-effective and environmentally friendly processing techniques for the manufacture of long superconducting tapes with a critical current density in excess of 1 MA/cm^2 and with low alternating current losses. At the same time, we are looking for new, more efficient and more easily handled superconducting materials, in particular as participants in a large European project.

ABOUT THE DEPARTEMENT

We focus on functional materials and their applications for sustainable energy technologies

FURTHER INFORMATION

www.energy.dtu.dk

CONTACT

Department of Energy Conversion and Storage
Technical University of Denmark, Risø Campus,
Frederiksborgvej 399, DK-4000 Roskilde,
Denmark

info@energy.dtu.dk, +45 4677 5800