NASA TECH BRIEF

NASA Headquarters

Magnets with Stabilized Conductors

The problem:

In the fabrication of large superconducting magnets, the high percentage of metal used to overcome instability (flux movement) is very costly. In a typical composite superconducting coil, the amount of metal used is about 100 times that of the superconductor material.

The solution:

A method has been developed to fabricate a stabilized composite conductor (for use in the construction of magnets) using equal amounts of superconducting and metal materials, thus reducing the weight, cost, and size.

How it's done:

A composite conductor is fabricated by preparing individual thin layers of a superconducting material (niobium nitride) and a high purity normal metal (copper). These layers are deposited on an appropriate substrate (stainless steel) in an alternate fashion. Superconducting films having excellent conducting properties are produced down to a thickness of about 200×10^{-8} cm. Once a layer of this film has been deposited on a substrate, a second layer consisting of a metal (having the desired electrical and thermal characteristics) is embedded onto the film. Alternate layers are then deposited until a sufficient thickness is achieved, which yields the desired current carrying properties.

When a magnet is in use, it is found that instability (flux motion) results in short sections of the superconducting solenoid becoming resistive, and the heat generated by passing currents through these resistive sections results in the loss of superconductivity in the magnet.

Use of very thin superconductor layers restricts the movement of flux and eliminates the fundamental cause of magnet instability. Even if flux motion did occur, the growth of the stabilizing normal metal onto the superconductor presents a low thermal resistance interface between the two materials. Any excessive heating generated by flux motion is dissipated.

This composite conductor, when used in the windings of magnets or in rotating machinery, minimizes or eliminates the problems of instability that now exist.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Headquarters
Code KT
Washington, D.C. 20546
Reference: TSP72-10465

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 V.S.C. 2457 (P)], to the Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

Source: C. K. Jones and J. R. Gavaler of
Westinghouse Electric Corp.
under contract to
NASA Headquarters
(HQN-10727)

Category 04, 03