NASA TECH BRIEF
Lewis Research Center

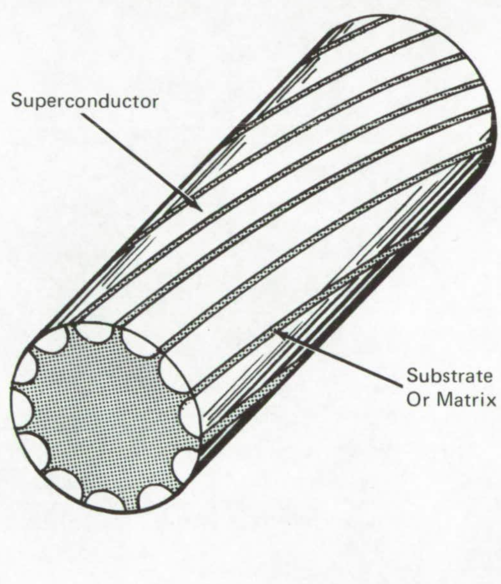
New Twisted Intermetallic Compound Superconductor: A Concept

A method has been conceived for processing Nb_3Sn and other intermetallic compound superconductors to produce a twisted, stabilized wire or tube which can be used to wind electromagnets, armatures, rotors, and field windings for motors and generators as well as other magnetic devices.

There are presently no methods of producing these superconductors in a twisted (and/or superimposed) configuration for stabilized dc or ac operation of superconductive devices. When the current in a coil is changing (during turn-on, for example), the various fine filaments in a composite conductor will have additional currents induced in them by the changing magnetic flux. Twisting the filaments reduces these extra currents and consequently reduces the amount of heating that occurs when these currents collapse because of the temporary loss of superconductivity during "flux-jumps." The heating that accompanies "flux-jumps" can cause the loss of superconductivity in all or a significant part of a coil.

Methods of processing alloy superconducting composites with the filaments twisted (and/or superimposed) are in common practice. But these alloy superconductors, such as NbTi can produce neither the intense magnetic fields nor the high current density of the intermetallic compounds. It is not practical to use NbTi to produce fields higher than about 90 to 100 kilogauss (9 or 10 tesla). Superconducitvity is completely destroyed in NbTi by a field strength of 12 tesla, and NbTi has very little current carrying capability unless the field is below 10 tesla. The Nb_3Sn, on the other hand, maintains useful current carrying ability to 15 or 16 tesla, and its superconductivity is not totally destroyed until about 22 tesla. The application of NbTi conductors is limited to moderate-strength fields produced with heavy conductors unsuitable for applications where small size and low weight are necessary.

In this conceptual method, a wire or tube of the desired substrate material (such as niobium, steel, or similar materials) is extruded, swaged, or drawn with multiple grooves along the length of the substrate. After the substrate is prepared, it can be twisted, as shown in the figure, to give the required number of twists/cm. Then a coating of the intermetallic, such as Nb_3Sn, can be formed in the grooves by vapor deposition or a diffusion technique. Preparation of the substrate for the vapor deposition process may require masking the lands or sections between the grooves with a material resistant to the deposition process. This conductor is then suitable for winding into various coil configurations.



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The advantage of this process over the prior art is that the Nb_3Sn conductors can be twisted while tapes or ribbons of the prior methods cannot be. This technique decreases the magnitude of induced currents; thus, local disturbances are kept small, and "hot spots" do not propagate.

Note:

No further documentation is available. Technical questions, however, may be directed to:

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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
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