Fine-Filament MgB_2 Superconductor Wire

For turboelectric aircraft propulsion systems and numerous commercial uses

Hyper Tech Research, Inc., has developed fine-filament magnesium diboride (MgB_2) superconductor wire for motors and generators used in turboelectric aircraft propulsion systems. In Phase I of the project, Hyper Tech demonstrated that MgB_2 multifilament wires (<10 micrometers) could reduce alternating current (AC) losses that occur due to hysteresis, eddy currents, and coupling losses. The company refined a manufacturing method that incorporates a magnesium-infiltration process and provides a tenfold enhancement in critical current density over wire made by a conventional method involving magnesium-boron powder mixtures. Hyper Tech also improved its wire-drawing capability to fabricate fine multifilament strands.

In Phase II, the company developed, manufactured, and tested the wire for superconductor and engineering current density and AC losses. Hyper Tech also fabricated MgB_2 rotor coil packs for a superconducting generator. The ultimate goal is to enable low-cost, round, lightweight, low-AC-loss superconductors for motor and generator stator coils operating at 25 K in next-generation turboelectric aircraft propulsion systems.

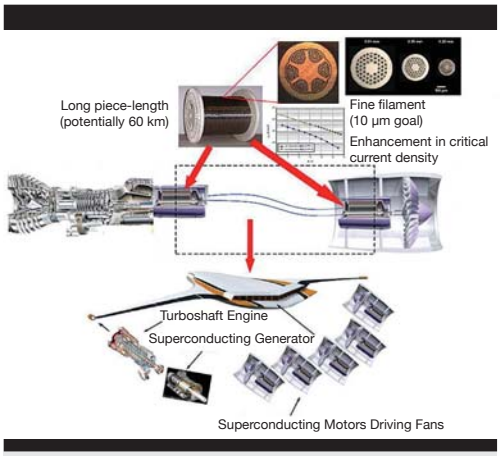
Applications

NASA

- Stator coils for all-electric aircraft
- Generators
- Motors
- Transformers
- Inductors
- Power conditioning equipment
- Magnetic bearings
- Actuators
- Magnetohydrodynamic magnets
- Propulsion engines
- Magnetic shielding in space
- Magnetic launch devices

Commercial

- Rotor coils for motors and generators
- Background magnets for magnetic resonance imaging (MRI) devices
- Inductive-type superconducting fault current limiters
- Resistive fault current limiters
- Low-speed direct-drive wind turbine generators
- Stators for generators and motors (50–400 Hz)
- Transformers
- Reactors
- Inductors



Hyper Tech Research, Inc. illustration

Phase II Objectives

- Develop high-filament-count, single-restack MgB_2 superconductors
- Optimize the double-restack conductor
- Reduce the twist pitch and develop MgB_2 conductors with a reduced number of magnetic components
- Develop MgB_2 superconductors with reduced transport current losses and different versions of MgB_2 cables
- Develop low-AC-loss second-generation MgB_2 superconductor wire
- Characterize the superconductivity and AC losses of MgB_2 wire, cables, and racetrack coils
- Deliver low-AC-loss MgB_2 wire to NASA and other collaborators
- Outline a follow-on Phase III program

Benefits

- Low cost
- Lightweight
- Low density
- Configurable in any critical current as a round wire
- Low AC loss

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