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Science and Technology for Tomorrow's Air and Space Force

Success Story

YBCO-COATED CONDUCTOR GETS GO-AHEAD FOR FULL DEVELOPMENT



A novel flat wire conductor, prepared by coating a metal substrate with yttrium barium copper oxide (YBCO), produces a significantly higher current-carrying capacity over conventional copper wire. It is the next-generation, high-temperature superconducting wire necessary for the development of Air Force directed energy weapons and the Navy's Electric Warships & Combat Vehicles programs. System components benefiting from the conductor include power generators, high-frequency source magnets, transformers, and motors.

Liquid cryogenics are not used to cool the superconductors because highly reliable commercial refrigerators are available to provide the necessary cooling. Specific commercial advantages include three to five times more power capacity than conventional power cables and elimination of cooling oil in transformers to reduce fire and environmental hazards. Superconducting motors and generators will be much more efficient and less expensive than their conventional counterparts.



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Accomplishment

Mr. Pete Aldridge, Under Secretary of Defense, recently gave final approval for full development of YBCO-coated conductors under Title III of the Defense Production Act. The Department of Energy Office of Power Technologies and the Department of Defense (DoD) Defense Production Act–Title III Office are currently setting aside \$12 million in federal funds to combine with \$12 million in industrial funding to ensure availability of YBCO-coated conductors in long-length sections.

The Title III approval sets in motion private sector production capabilities to support manufacturing of the YBCO-coated conductor. Propulsion Directorate scientists are actively involved in furthering development of YBCO-coated conductors.

Background

The need for compact, lightweight, high-power generators and magnets is critical to new defense applications. DoD needed a superconductor that operates at higher temperatures to reduce the cooling requirement of conventional machines or cryogenic refrigerators for low-temperature superconductors, which are 10 to 100 times larger. The new high-temperature superconducting technology competes with both conventional and low-temperature superconducting rotating machines.

By simply substituting the YBCO-coated conductor technology for today's conventional copper/iron core technology or low-temperature superconductor technology, high-speed, high-temperature superconducting generators can produce megawatts of electrical power while weighing up to 80% less. These size and weight reductions enable high-power-dependent weapon systems on air or mobile platforms, opening the door to airborne applications such as directed energy weapons.

Tremendous benefits also exist for commercial applications. Establishing an industrial manufacturing capability for the YBCO-coated conductor will lead to commercialization in electric power applications such as transformers, transmission cables, motors, and generators.

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (03-PR-08)

Propulsion
Technology Transfer