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SELF-REROUTING AND CURATIVE INTERCONNECT TECHNOLOGY (SERCUIT)

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The primary goal of Phase I of fabricating and characterizing autonomous self-healing current carrying composite conductors is achieved. A conductive blend of CB powder and Surlyn® pellets is prepared using microcompounder and a single screw extruder. The volume fraction of conductive filler is designed to provide conductivity comparable to traditional wires in the undamaged state for normal operation. When this blend is used as the primary conductor, damage to it can be healed by means of controlled arcing or resistive heating depending on the extent of the damage.

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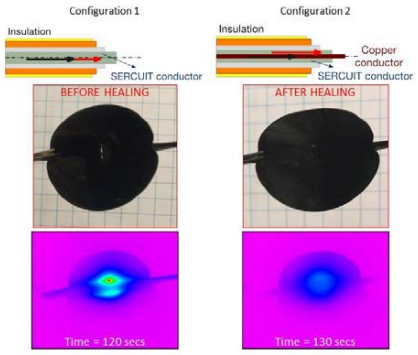

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Title

SELF-REROUTING AND CURATIVE INTERCONNECT TECHNOLOGY (SERCUIT)

Contract Number

W911W6-17-C-0029

SBIR Topic Number

A16-101

Proposal Number

A163-101-0037

Summary Report Type

Phase I Final

Description and Anticipated Benefits

The primary goal of Phase I of fabricating and characterizing autonomous self-healing current carrying composite conductors is achieved. A conductive blend of CB powder and Surlyn® pellets is prepared using microcompounder and a single screw extruder. The volume fraction of conductive filler is designed to provide conductivity comparable to traditional wires in the undamaged state for normal operation. When this blend is used as the primary conductor, damage to it can be healed by means of controlled arcing or resistive heating depending on the extent of the damage. In more likely wire architecture, copper conductor is surrounded by the healing/rerouting conductive blend sheath. Copper core serves as the primary current carrying conductor and the composite layer serves as an alternate current carrying self-healing pathway in case of damage to the copper wire or both. The electrical, thermal, and healing properties of these conductive blends have been studied to validate their use in electrical wiring systems. It is demonstrated that the conductive blend autonomously heals with controlled microscopic arching-induced polymer melt reflow in the close vicinity of damage to reestablish the conductive path. C2Si team successfully established feasibility of the proposed SERCUIT concepts and down selection of the technology meeting topic criteria at a proof-of-concept level. In Phase II, C2Si is partnering with the established wire manufacturer for military and civilian markets, Parker Hannifin Corporation, and a defense prime contractor, Boeing Corporation, to facilitate the transition. C2Si will license the technology to Parker Hannifin Corporation to manufacture wiring harnesses to flow down requirements by Boeing. Further maturation of the technology will open up wider utilization of this technology in military as well as much wider commercial systems market. This capability could be beneficial in automotive sector as well that already uses a large quantity of wiring that only going to increase with autonomous vehicles on horizon and demand for reliable and robust wiring solutions. It will also open up boat and ship structural applications. In general the technology will be suitable for reliable transportation systems, space exploration systems and satellites where failure can results in extreme losses. Many countries are extending the life of their military fleet through service life extension programs involving upgrades and retrofits rather than purchasing new aircraft. Navy data on wiring issues suggests that as many as one million man-hours are spend annually in troubleshooting, isolating,

locating and fixing wiring faults. Naval Air Systems Command (NAVAIR) data suggests that nearly as many hours are spent on unscheduled wiring maintenance as on scheduled maintenance. Further, the data collected by NAVAIR indicated that chafing contributed to more than a third (37%) of all wiring failures on Navy aircraft during the period 1980-1999. Moreover, despite the fact that chafing, or the erosion of insulation and the exposure of conductor, is a known problem, and the tools to resolve it are available, analysis of data from the years 2000 to 2004 show that chafing remained the major wire failure modes on Navy aircraft. Fully 30% of aircraft with more than 70,000 hours were found with severe chafing and bare wires. Based on these indicators, C2Si will be in a position to quickly commercialized our autonomous healing and rerouting technology.
