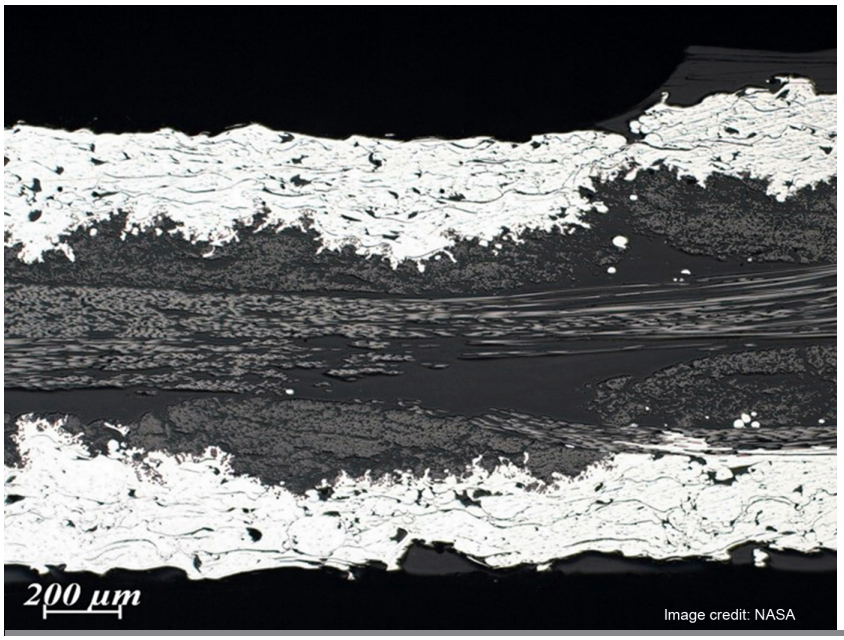

Image credit: NASA

National Aeronautics and Space Administration

NASA

TECHNOLOGY SOLUTION

Manufacturing

Fiber-Metal Laminate Manufacturing Technique

Synthesis of fiber-metal laminates by RF plasma spray deposition

NASA Langley Research Center has developed a method for the synthesis of fiber-metal laminates by radio frequency plasma spray deposition. Fiber-metal laminates (FMLs) combine the stiffness and strength of fiber-reinforced polymer matrix composites with the toughness and durability of metallic alloys and, therefore, have a range of applications. The use of radio frequency plasma spray (RFPS) deposition offers a unique approach to the fabrication of FMLs with many advantages. For example, the approach is ideal for highly reactive materials, allows for tailorable FMLs, and allows for materials that exploit the unique properties of nanoparticles in metallic structures. This new manufacturing technique will help create better FMLs for lighting strike protection and also open the door to new FML applications.

BENEFITS

- Tailorable FMLs provide multi-functionality for improved structural efficiency
- Efficient manufacture of difficult-to-process materials
- Unique combinations of metal/fabric/polymer possible

THE TECHNOLOGY

Fiber-Metal Laminates (FMLs) are composite materials that consist of conventional fiber reinforced plastics with the addition of a metal component, typically a foil or mesh layer(s). The metal component offers the advantage of incorporating metal-like properties to the composite construction. While a range of potential advantages and applications have been discussed for FMLs, the primary application to date has been for aircraft structures, with one potential advantage being the lightning strike protection (LSP) offered by the improved electrical conductivity. As aircraft construction has moved to composite structures, there has been an increasing need for such conductive composites. Similarly, with increasing use of composites for other large structures, e.g. wind turbines, there are an increasing number of potential applications for lightning strike protection materials. Other advantages of FML are improved impact and fire resistance.

This innovation provides a method for making FML materials that incorporate nanotube reinforcement. The method involves the use of RF plasma spray to directly form and deposit nanotube materials onto fibers/fabrics, which can then be manufactured into composite structures by infiltrating the fiber with resin, and consolidating the structure via autoclave processing or via the use Vacuum Assisted Resin Transfer Molding (VARTM) composite manufacturing methods. Nanotubes incorporated into the structure in this manner can be of several types, for example boron nitride or carbon nanotubes. The objective of this innovation is to incorporate the nanotube materials in the FML in order to improve the mechanical properties.

Plasma spray deposition. Image credit: NASA

APPLICATIONS

The technology has several potential applications:

- Aerospace lighting strike protection
- Blast protection
- Impact resistance
- Controlled electrical/ thermal conductivity
- Radiation shielding

PUBLICATIONS

Patent No: 9,963,345

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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