National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Healable Carbon Fiber Reinforced Composites

Puncture- healing thermoplastic resin carbon fiber reinforced composites towards more damage/impact tolerant systems

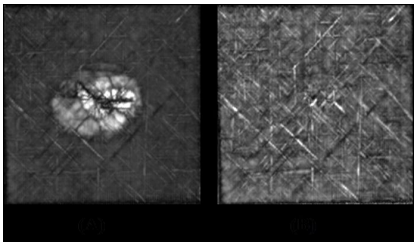
NASA Langley Research Center has developed carbon fiber reinforced composites with self-healing properties. The initiation and propagation of damage to carbon composites, such as in aircraft structural components, results in component failure. Typical structural repairs result in damaging practices, where material is ground away and holes are drilled to secure patches, which can act as new sites for damage. This technology exhibits effective self-repair that heals quickly following low to mid velocity impacts, while retaining structural integrity.

BENEFITS

- Healable system following low to mid velocity impacts
- Aerospace quality carbon fiber composites
- Extends life of typical carbon fiber components
- Self-healing properties do not require microcapsules, which can act as defect initiators

THE TECHNOLOGY

A composite fabrication process cycle was developed from composite precursor materials developed at LaRC to fabricate composite laminates. The precursor material is a pre-impregnated unidirectional carbon fiber preform, or prepreg. In the pre-pregging process, the high strength, structural reinforcing carbon fiber is wetted by a solution containing a self-healing polymer. The resulting material is of aerospace quality and exhibits a significant decrease of internal damage following impacts tests (using ASTM D 7137 standard).



Through transmission c-scan of Healable composite panel post-impact (A) and post-impact, post-healing cycle (B).

APPLICATIONS

The technology has several potential applications:

- Aircraft
- Rotocraft
- Spacecraft
- Missiles

PUBLICATIONS

Patent No: 9,156,957; 9,783,648; 10,450,432

PROCESSING AND DAMAGE TOLERANCE OF CONTINUOUS CARBON FIBER COMPOSITES CONTAINING PUNCTURE SELF-HEALING THERMOPLASTIC MATRIX. Brian W. Grimsley, Keith L. Gordon, Michael W. Czabaj, Roberto J. Cano, and Emilie J. Siochi. SAMPE 2012, May 21-24, 2012.
https://ntrs.nasa.gov/citations/20120009199 < > <
> FRACTURE TOUGHNESS OF CARBON FIBER COMPOSITES CONTAINING VARIOUS FIBER SIZINGS AND A PUNCTURE SELF-HEALING THERMOPLASTIC MATRIX. Roberto J. Cano, Brian W. Grimsley, James G. Ratcliffe,Keith L. Gordon, Joseph G. Smith Jr., and Emilie J. Siochi. CAMX 2015: The Composites and Advanced Materials Expo.
https://ntrs.nasa.gov/citations/20160006366

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.

LAR-18131-1, LAR-18131-2, LAR-18131-3, LAR-TOPS-136

More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

Langley Research Center

Mail Stop 020
Hampton, VA 23681
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

NP-2015-06-1916-HQ