National Aeronautics and Space Administration

Materials and Coatings

Sensory Metallic Materials

Particles that can be embedded into metallic alloys to improve nondestructive evaluation of a structure

NASA Langley Research Center has developed a metallic material that can be embedded into structural alloys to enhance nondestructive evaluation (NDE) of a structure. Current NDE tools, such as Eddy current probes and others, can have some difficulties detecting small flaws in certain materials and structures. Also, using them can be costly, time consuming, and labor intensive, often resulting in significant downtime in the case of examination of machinery and vehicles. This innovation is to embed particles that react to strain with easily detected acoustic emissions and change in magnetic properties.

BENEFITS

- Reduction of equipment and wiring required for nondestructive evaluation
- Ability to customize the threshold deformation level for detection
- Decreased structural weight since factors of safety can be reduced
- Reduced need for routine inspection and part replacement
- Increased structural reliability
- Increased intervals of component replacement
- Ability to detect damage at its earliest stage (e.g., microcracking)

APPLICATIONS

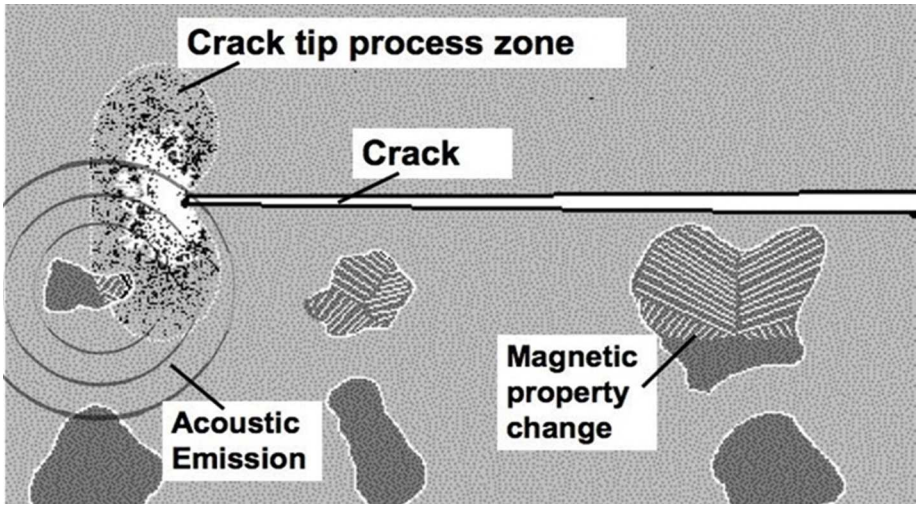
- Aerospace vehicles and aircraft
- Any applications where monitoring total overload or localized strain is critical

technology solution

THE TECHNOLOGY

While almost all advancements in nondestructive evaluation (NDE) focus on improving the NDE equipment and techniques, any testing is inherently limited by the response of the materials being tested. This technology seeks to improve the response of the material itself by embedding shape memory alloy (SMA) particles in the metallic structural alloy in a manner that does not compromise the structural integrity of the material.

These SMA particles undergo a martensitic phase change (crystallographic change) in response to strain (e.g., a crack tip causing local deformation). The phase change produces an acoustic emission and a change in magnetic properties that can easily be detected and monitored, providing a means for enhanced NDE. The advantage is either that (1) the technology makes available existing NDE techniques that were not applicable before because of the type of structural material being used (the particles add new physics to the base structure) or (2) the technology enhances NDE because the SMA particles create conditions that are easier to detect damage relative to the equivalent level of damage in a structure without particles.



Damage process zone interacting with sensory particles

PUBLICATIONS

Patent Pending

More Information

National Aeronautics and Space Administration

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