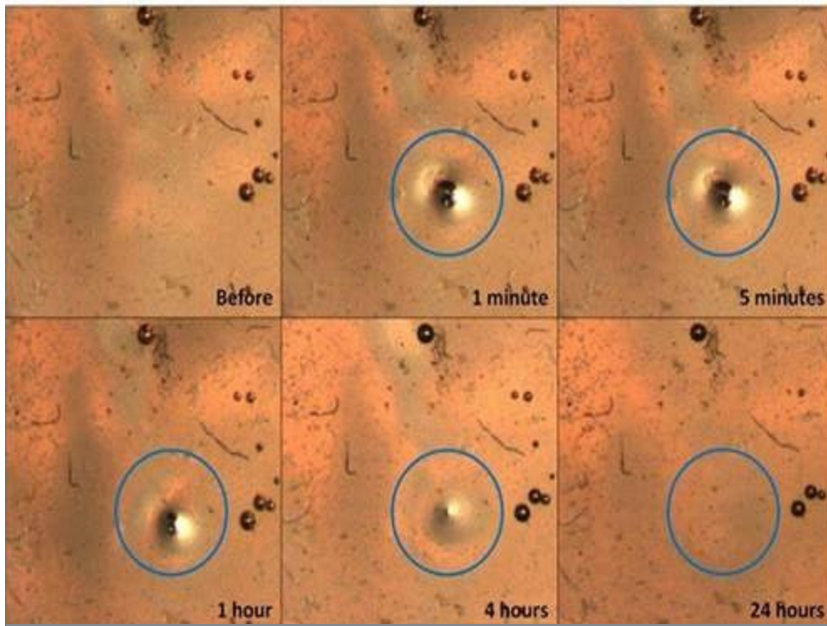




TECHNOLOGY SOLUTION

Materials and Coatings



Self-Healing Low-Melt Polyimides

Flexible thin-film polyimides can self-repair minor cuts, nicks, and abrasions

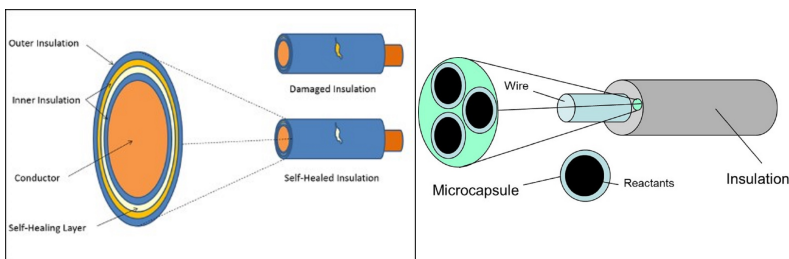
NASA Kennedy Space Center seeks partners interested in the commercial application of a thin-film, high performance, polyimide and self-healing/sealing systems for nearly a decade. (KSC) is now seeking commercial partners for licensing or further development of these novel high performance, flexible, low-melt polyimide film with self-healing properties. The self-healing/sealing properties of the materials are provided as a self-sealing polyimide film, a layered composite, as a healant in embedded microcapsules, or combination thereof. When cut or otherwise damaged, the self-sealing film and/or microcapsule healant will result in a repair of the damaged area. The capability to heal or self-repair in such applications as wire insulation, inflatable structure inner linings, spacesuits, and solar panels is a key technology area for NASA, and developmental testing of these novel materials has shown great promise.

BENEFITS

- **Reduced Maintenance** - Self-healing of minor cuts, nicks, and abrasions on wire insulation, solar panels, and inflatable structures can substantially reduce the need to perform inspection, troubleshooting, repair, and/or replacement of damaged parts.
- **Reduced Cost** - Wiring and sub-assemblies incorporating self-healing surfaces can self-repair minor damage, thus greatly reducing the cost of materials and labor required for the repair or replacement of damaged wiring and parts.
- **Improved Reliability** - Self-healing of minor damage can help improve system mean-time-between-failure. Damage (e.g., shorting, sparking, crack propagation, degradation of barrier integrity) that would otherwise continue worsening and lead to failure is repaired without maintainer intervention or further system degradation.
- **Improved Safety** - Self-healing capability in wire insulation helps prevent shorts which can lead to sparking and conditions conducive to fires. Self-healing of minor damage to spacesuits or inner liners of inflatables helps prevent loss of pressurization and loss of life.

THE TECHNOLOGY

There are multiple space-related systems that can benefit from high performance, thin film, self-healing/sealing systems. Space vehicles and related ground support equipment can contain miles of wire, much of which is buried inside structures making it very difficult to access for inspection and repair. Space-based inflatable structures, solar panels, and astronauts performing extra-vehicular activities are subject to being struck by micrometeoroids and orbital debris. Self-healing or sealing layers on inflatables, solar panels and spacesuits would increase the safety and survivability of astronauts as well as the survivability and functionality of inflatables and solar panels. Self-healing insulation on wiring would greatly improve the reliability and safety of systems containing such wiring and reduce inspection and repair time over the lifetime of those systems. This technology combines the use of a self-sealing low melt, high performance polyimide film that exhibits the ability, when cut, for separated edges to slowly flow back together and seal itself, with the options of a laminate system and the inclusion of healant microcapsules that, when broken, release healant which can then additionally assist in the healing process. Combinations of the healing approaches can be enabling to the healing process proceeding at a much greater rate and dual mode healing approach can also allow for healing of a larger area.



Self-Healing Wire Insulation Diagram

Self-Healing Wire Insulation Layer
Microcapsules

APPLICATIONS

The technology has several potential applications:

- Aerospace (Aircraft, Helicopters, Rockets, Expandable or Inflatable structures/architectures)
- Defense (Missiles, Ground Vehicles, Habitation Tents)
- Ships, Submarines, Unmanned Aerial Vehicles)
- Automotive
- Power Production (Wiring, Solar Panels)
- Textiles
- Protective Coatings

PUBLICATIONS

Patent No: 8,119,238; 10,174,198