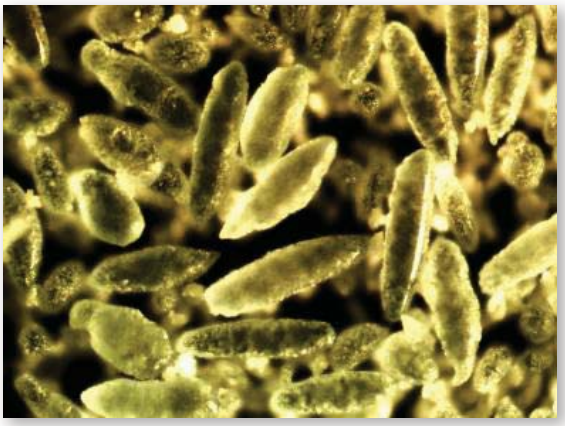
Non-Spherical Microcapsules For Increased Core Content Volume Delivery Project

Center Innovation Fund: KSC CIF Program

Space Technology Mission Directorate (STMD)

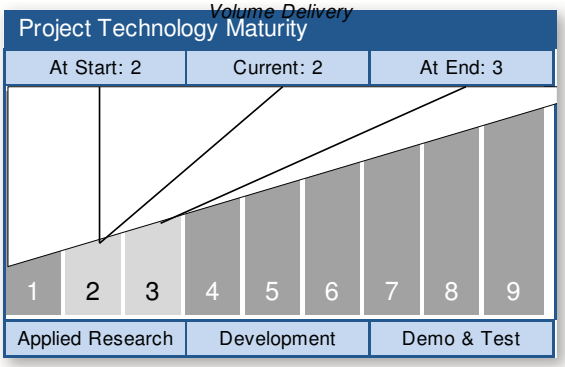
National Aeronautics and Space Administration



ABSTRACT

The goal of this project was to advance microencapsulation from the standard spherical microcapsule to a non-spherical, high-aspect ratio (HAR), elongated microcapsule. This was to be accomplished by developing reproducible methods of synthesizing or fabricating robust, non-spherical, HAR microcapsules. An additional goal of this project was to develop the techniques to the point where scale-up of these methods could be examined. Additionally, this project investigated ways to apply the microencapsulation techniques developed as part of this project to self-healing ...***Read more on the last page.***

Non-Spherical Microcapsules for Increased Core Content Volume Delivery



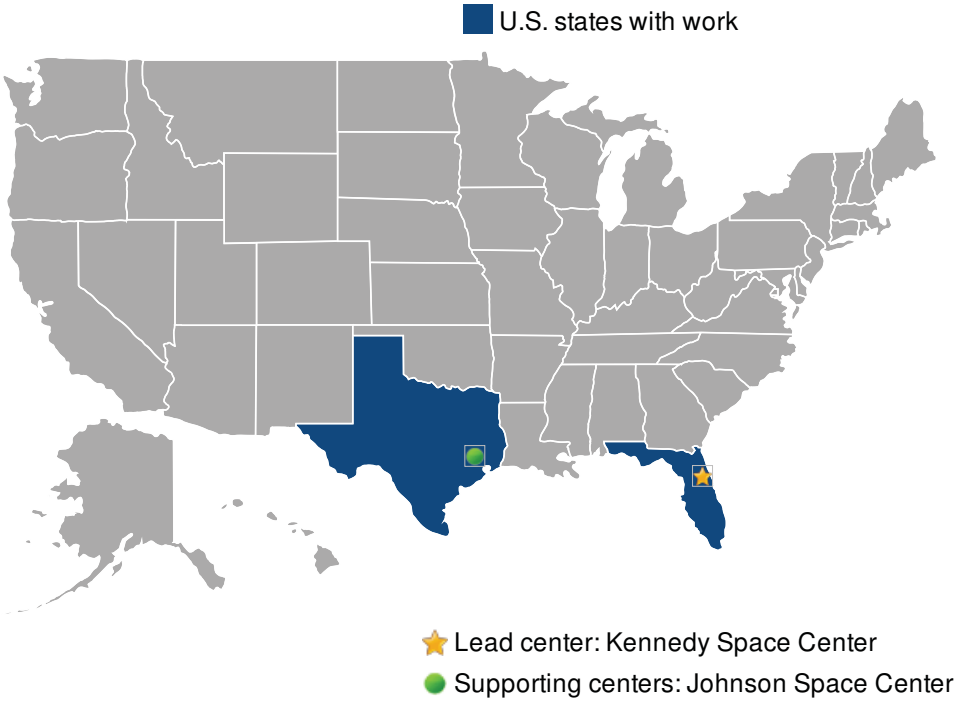
Technology Area: Space Power & Energy Storage TA03 (Primary)
Ground & Launch Systems Processing TA13 (Secondary)

ANTICIPATED BENEFITS

To NASA unfunded & planned missions:

New designs for shearing methods were developed which allowed the production of healant-filled microcapsules with aspect ratios between 2 to 1 and 4 to 1. This method, which yielded more uniform, robust nonspherical microcapsules, was scaled up to a larger volume (still at laboratory scale) with good reproducibility. A patent was filed for this method of synthesizing nonspherical microcapsules in 2012. Additional intellectual property is ...

Read more on the last page.



Other Organizations Performing Work
QinetiQ North America/ESC

DETAILED DESCRIPTION

This project had three primary objectives, all of which have been addressed:

• Assess the state-of-the-art for microcapsules and self-healing systems

• Evaluate reproducible methods of synthesizing or fabricating robust, nonspherical microcapsules and develop new technology where applicable

• Evaluate the use of nonspherical microcapsules in self-healing applications such as wire insulation

MANAGEMENT

Program Executive:
John Falker

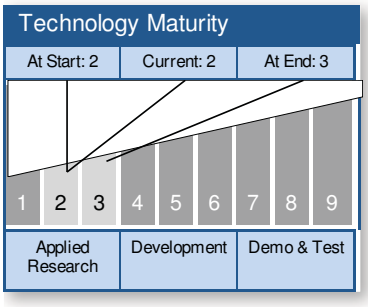
Program Manager:
Nancy Zeitlin

Project Manager:
Nancy Zeitlin

Principal Investigator:
Martha Williams

TECHNOLOGY DETAILS

Non-Spherical Microcapsules for Increased Core Content Volume Delivery and Chemical Resistance



TECHNOLOGY DESCRIPTION

If systems such as wiring insulation, inflatables, and habitation structures had a way to automatically heal tears, abrasions, and other damage, that ability would significantly increase their reliability, reduce their life cycle costs, and improve the safety of the operations and larger systems they support (commercial and defense aircraft, extended space missions, surface exploration, etc.). Kennedy Space Center (KSC) has been developing self-healing technologies and has established intellectual property in this area. One of KSC's approaches is encapsulating healants in spherical microcapsules so they can be released automatically when the system is damaged. The healant fills the voids that form as the damage occurs. But to overcome challenges in spherical microencapsulation, innovative ideas and approaches are required.

This technology is categorized as a material for other applications

- Technology Area
    - TA03 Space Power & Energy Storage (Primary)
    - TA13 Ground & Launch Systems Processing (Secondary)
    - TA06 Human Health, Life Support & Habitation Systems (Additional)
    - TA12 Materials, Structures, Mechanical Systems & Manufacturing (Additional)

CAPABILITIES PROVIDED

Self-healing capability. The achievement of nonpermeable, non-leaching microcapsule walls to allow only delivery of healant upon demand of damage remains a challenge, although advances have been made in formulation and annealing. Still under evaluation are the addition of microcapsules to matrices and the chemical compatibilities necessary for healants to be released when damage occurs.

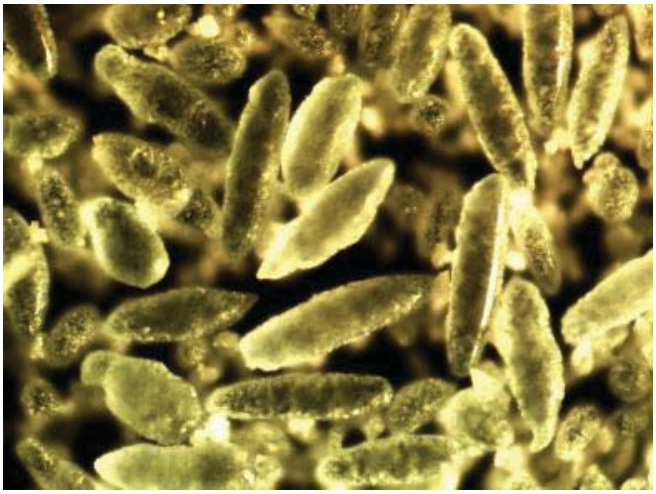
NASA Kennedy Space Center worked with commerical company to understand technical challenges in using microencapsulated healants and self-healing materials in such applications as wiring insulation. Potential self healing applications for inflatable bladder materials were also addressed with NASA Johnson Space ...

TECHNOLOGY DETAILS

POTENTIAL APPLICATIONS (CONT'D)

Center.

IMAGE GALLERY



Optical micrograph of nonspherical, high-aspect-ratio microcapsules.

ABSTRACT (CONTINUED FROM PAGE 1)

formulations.

ANTICIPATED BENEFITS

To NASA unfunded & planned missions: (CONT'D)

expected.

To other government agencies:

Self healing technologies would also be very beneficial to satellites, military and commercial aviation needs.

To the commercial space industry:

Game changing impacts for deep space exploration and habitation missions, as well as satellites, military, and commercial aviation needs could be expected. Potentially significantly reduce life cycle cost and increase safety; increase reliability by at least 2X, and mission availability to at least 200%.

To the nation:

Such technologies also could have many additional uses, such as in the medical industry to help ensure healing of artificial skin and drug discovery. Industry has shown significant interest in self-healing technologies.