

Development Of New Dielectric NDE Techniques For Spaceflight Materials Project

Center Independent Research & Developments: KSC IRAD Program
Mission Support Directorate (MSD)

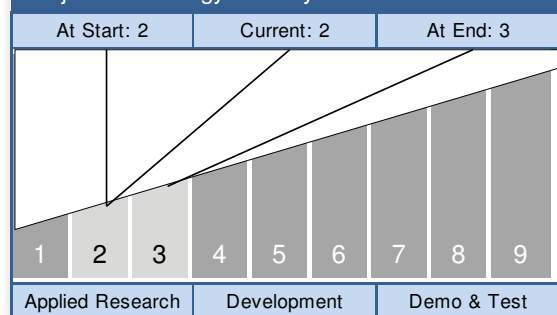
National Aeronautics and
Space Administration



ABSTRACT

Dielectric Spectroscopy is a relatively new technique for nondestructively measuring material properties. The goal for this project is to extend the use of state-of-the-art dielectric spectroscopy systems to measure the spectra of spaceflight materials and develop non-destructive evaluation (NDE) sensors based on dielectric material properties. This work may lead to a new class of material density, moisture, temperature, and defect sensors providing structural integrity and health measurements for future spacecraft and launch ...***Read more on the last page.***

One of two Novocontrol Concept 80 Broadband Dielectric Spectrometers used to characterize the project materials.
Project Technology Maturity



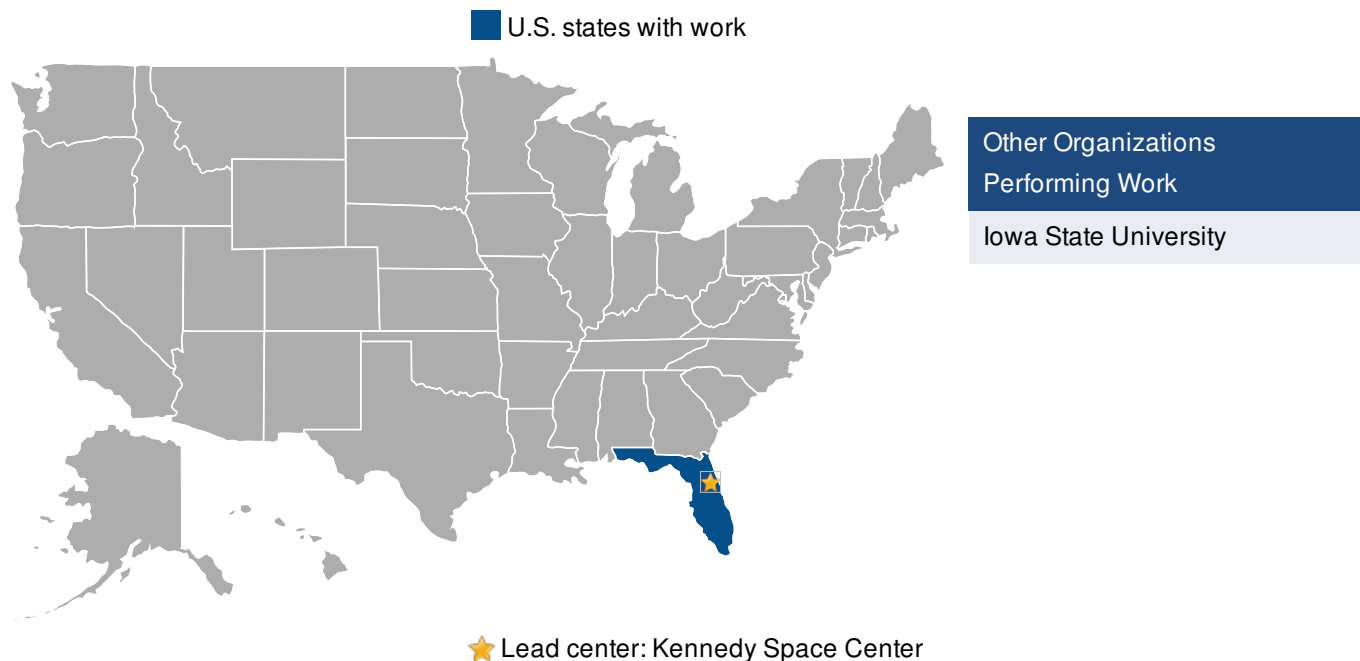
Technology Area: Materials, Structures, Mechanical Systems & Manufacturing TA12 (Primary)

ANTICIPATED BENEFITS

To NASA funded missions:

KSC is using two Novocontrol Broadband Dielectric Spectroscopy systems to characterize the dielectric properties of spacecraft materials over a broad frequency range. Measuring the spectra of these materials over such a wide range of conditions will likely show "fingerprints" to help distinguish material problems such as structural degradation, and moisture uptake. These "fingerprints" would serve as a basis for developing new sensing and visualization techniques based on capacitance or impedance measurements. This will help alleviate the ...

Read more on the last page.



DETAILED DESCRIPTION

A Novocontrol Concept 80 Broadband Dielectric Spectrometry system will be used to measure the complex dielectric spectrum for select spaceflight materials. Samples with known defects will be measured to serve as a comparison to known good samples. Materials that are known to have problems with moisture absorption will be measured after exposure to different moisture levels to see how the complex permittivities vary with moisture content.

Analysis will be performed on the spectra to determine the extent to which damage and moisture can be quantified for each of the materials. Concepts for new NDE techniques and sensors will be proposed based on the results of the analysis.

Materials targeted to be tested include heat shield materials, such as PICA, AVCOAT, and high performance ...

MANAGEMENT

Program Manager:
Burton Summerfield

Project Manager:
Mark Nurge

Principal Investigator:
Mark Nurge

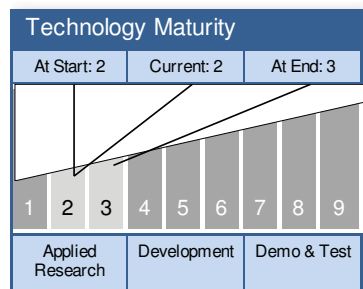
DETAILED DESCRIPTION (CONT'D)

polymers.



TECHNOLOGY DETAILS

New dielectric NDE techniques for spaceflight materials



TECHNOLOGY DESCRIPTION

Broadband dielectric spectrometers can measure the complex dielectric properties of spacecraft materials over a frequency range of 3 μHz – 3 GHz, and a temperature range of -160 °C – 400 °C. Measuring the spectra of these materials over such a wide range of conditions will likely show “fingerprints” to help distinguish material problems such as voids, structural degradation, and moisture uptake. These “fingerprints” would serve as a basis for developing new sensing and visualization techniques based on capacitance or impedance measurements. This will help alleviate the lack of existing non-destructive evaluation (NDE) techniques for detecting moisture absorption and certain structural defects in these types of materials.

The data has yet been fully analyzed, but some of the samples are showing changes in their physical parameters due to the accelerated weathering exposure. Measurement techniques will be suggested based on the trends identified during analysis.

This technology is categorized as a hardware system for ground scientific research or analysis

- Technology Area
 - TA12 Materials, Structures, Mechanical Systems & Manufacturing (Primary)

CAPABILITIES PROVIDED

Often, the first time our non-destructive evaluation lab encounters a material it is to characterize a defect or examine a problem area in the material. The data from this study will help them more quickly identify the proper NDE technique to apply to the problem. Additionally, some newer sensing techniques may be proposed for select materials in the study.

The primary end users of this study will be the non-destructive evaluation community. Trends noted in the analysis could serve as the basis for new NDE methods and sensors.

GSDO, MPCV, SLS, & Commercial Crew programs will all be using materials that can degrade when exposed to the moist Florida environment. Sensing techniques will be needed to ensure moisture ...

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TECHNOLOGY DETAILS

POTENTIAL APPLICATIONS (CONT'D)

levels remain within the design tolerances after exposure.

IMAGE GALLERY



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ABSTRACT (CONTINUED FROM PAGE 1)

structures.

