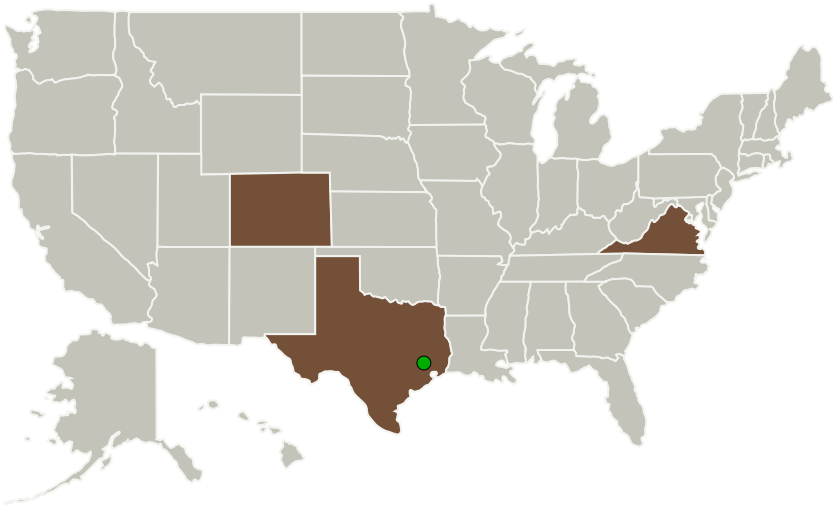
Ultra Low Air and H2 Permeability Cryogenic Bladder Materials for Inflatable Habitats, Phase I

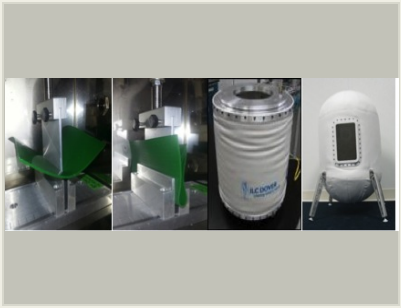
Completed Technology Project (2015 - 2016)

Project Introduction

NanoSonic has recently developed a hydrogen (H2) dispenser hose to realize H2 as a safe, reliable, and cost competitive replacement for gasoline. NanoSonic's ultra-low glass transition temperature (Tg of -100 ?C) is expected to meet the service requirement of 25,550 fills/year (70 fills/day for 2 years) at a combined ultra-high pressure of 875-bar and very wide service temperature range of -50?C to +90?C. This state-of-the-art lightweight hose (0.99 g/cc) is based on a unique fiber reinforced, high performance, cryogenically flexible polymer designed to resist hydrogen embrittlement, survive the Joule-Thompson effect thermal cycles, and endure mechanical wear and fatigue at the pump. This system is offered herein as large area panels that may be seamed via RF welding with our space partner, ILC Dover, to form inflatable habitat bladders. This superior class of low Tg polymers exhibited ultra-low air and H2 permeance (0.31 cc/100in2?Atm?day - post triple cold flex) before and after being subjected to the harsh, triple fold (180?) cold flexure (-50 ?C) test. Here, this non-electrically conductive polymer shall be reinforced herein with an engineered fiber design to dissipate static electricity and provide multifunctional radiation shielding. Additional multifunctionality shall be built in via NanoSonic's self-healing microspheres, while meeting the goal of < 6 oz/yd2 for a triply redundant bladder. NanoSonic shall work with our STTR partner, Colorado State University (CSU), Lockheed Martin Space Systems Company (LM SSC), and ILC Dover to qualify the advanced bladder material for space habitats.

Primary U.S. Work Locations and Key Partners





Ultra Low Air and H2 Permeability Cryogenic Bladder Materials for Inflatable Habitats, Phase I

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

Ultra Low Air and H2 Permeability Cryogenic Bladder Materials for Inflatable Habitats, Phase I

Completed Technology Project (2015 - 2016)

Organizations Performing Work	Role	Type	Location
Nanosonic, Inc.	Lead Organization	Industry	Pembroke, Virginia
Colorado State University-Fort Collins	Supporting Organization	Academia	Fort Collins, Colorado
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Colorado	Texas
Virginia	

Project Transitions

June 2015: Project Start

June 2016: Closed out

Closeout Summary: Ultra Low Air and H2 Permeability Cryogenic Bladder Materials for Inflatable Habitats, Phase I Project Image

Closeout Documentation:
- Final Summary Chart Image*(https://techport.nasa.gov/file/140777)*

Images

Briefing Chart Image
Ultra Low Air and H2 Permeability Cryogenic Bladder Materials for Inflatable Habitats, Phase I *(https://techport.nasa.gov/image/133318)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Nanosonic, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

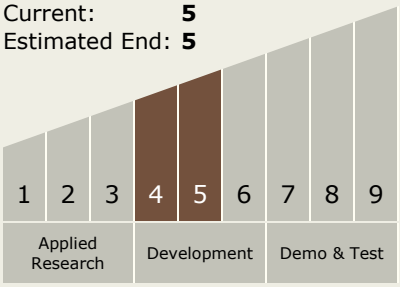
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Jennifer Lalli

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  └ TX12.1 Materials
    └ TX12.1.1 Lightweight Structural Materials

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System