Postponed Project (2012 - 2012)

Aerogel Use As A Skin Protective Liner In Space Suits And Prosthetic Limbs Project

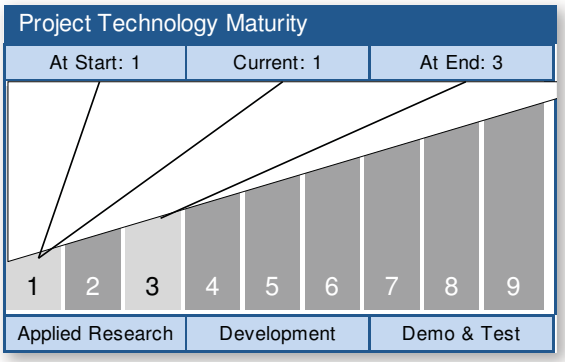
Center Independent Research & Developments: KSC IRAD Program

Human Research Science Management Office (SMO)

National Aeronautics and Space Administration

ABSTRACT

Existing materials for prosthetic liners tend to be thick and airtight, causing perspiration to accumulate inside the liner and potentially causing infection and injury. The purpose of this project was to examine the suitability of aerogel for prosthetic liner applications for use in space suits and orthopedics. Three tests were performed on several types of aerogel to assess the properties of each material, and our initial findings demonstrated that these materials would be excellent candidates for liner applications for prosthetics and space suits. The ...*Read more on the last page.*



Technology Area: **Human Health, Life Support & Habitation Systems TA06 (Primary)**
Materials, Structures, Mechanical Systems & Manufacturing TA12 (Secondary)

ANTICIPATED BENEFITS

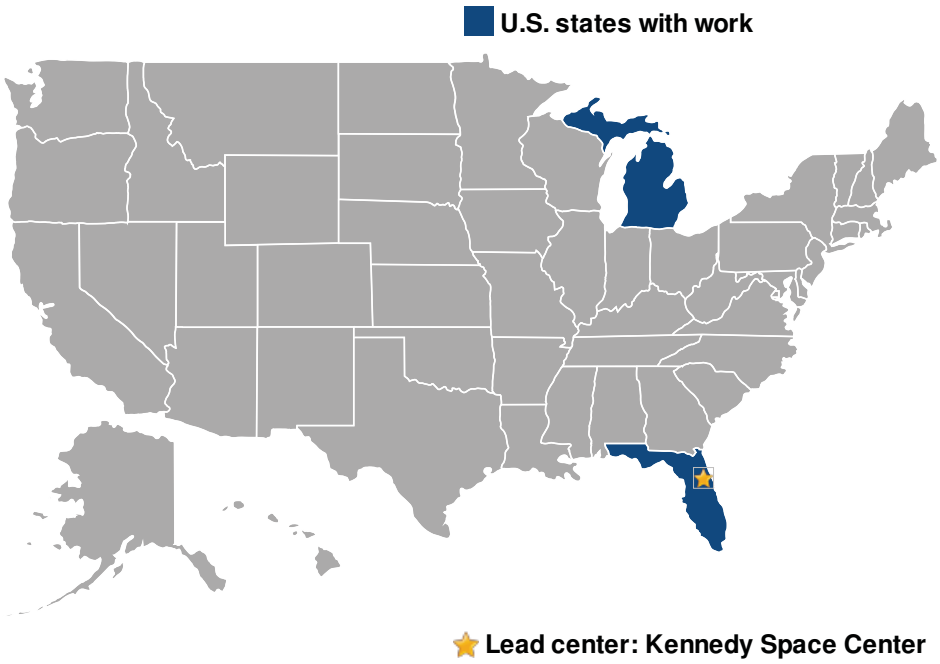
To NASA funded missions:

Long duration space missions and space walks will require new materials to protect the skin from injury and excessive moisture when in contact with inner linings of space suits. This technology would provide a series of materials for space suit designers to incorporate into their designs for future space explorers.

To other government agencies:

This work was performed in collaboration with the Tampa VA Hospital through ...

Read more on the last page.



Other Organizations Performing Work
Veteran's Administration, Tampa Hospital, Florida

Contributing Partners
Veteran's Administration, Tampa Hospital, Florida
Wayne State University, Michigan

MANAGEMENT

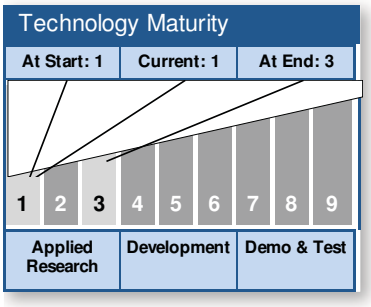
Principal Investigator:
Luke Roberson

DETAILED DESCRIPTION

Since the days of Neil Armstrong and Buzz Aldrin, the spacesuit has been one of the most crucial aspects of any human mission to space. The spacesuit has evolved over time but one thing that still remains problematic is the accumulation of perspiration and water on the astronaut's skin within the spacesuit gloves and boots. This accumulation is the cause of irritations and infections to the astronaut's skin and is very similar to the problems faced by amputees who wear airtight prosthetic liners. It is proposed that the developments of a hydrophobic, silica aerogel liner to be tested for applicability as a prosthetic liner. This aerogel liner would be very lightweight, durable, and comfortable while simultaneously preventing accumulation of perspiration and water on the skin. Should the material be successful as a prosthetic liner, it would then be proposed to be incorporated to the insides of the spacesuit gloves and boots.

TECHNOLOGY DETAILS

Aerogel Use as a Skin Protective Liner in Space Suits and Prosthetic Limbs



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This technology is categorized as a material for wearable applications

- **Technology Area**
  - **TA06 Human Health, Life Support & Habitation Systems (Primary)**
  - **TA12 Materials, Structures, Mechanical Systems & Manufacturing (Secondary)**

One of the biggest concerns in orthopaedic care of amputees is moisture control at the residual skin-prosthetic socket interface. The prosthetic liner, which fits the residual limb with an airtight seal, provides a mechanism of cushion and equal pressure distribution to the limb. However, the current polymers used to manufacture these prosthetic liners provide no inherent relief to the sweat produced from the residual skin, thereby causing an accumulation of moisture at the residual skin-prosthetic liner interface. This moist environment was reported to be the leading cause for many skin ailments on the residual skin leading to a high degree of discomfort and a significant decrease in the quality of life for the amputee.1 In the Veterans with amputation from the most recent OEF/OIF conflict 70% identified sweating in the socket as an issue.2 Skin ...

Performance Metrics		
Metric	**Unit**	**Quantity**
Load Bearing		
Moisture Vapor Permeability		

TECHNOLOGY DETAILS

CAPABILITIES PROVIDED (CONT'D)

breakdown is a major issue for people with amputations, and the trapped perspiration is a contributing factor. It can provide a place for bacterial to collect, and the contact with the skin can cause maceration.3-4 The research proposed here will attempt to improve the moisture management of the residual skin in a prosthetic socket by engineering a mechanism of moisture relief into the prosthetic liner itself. This will be achieved by utilizing the unique material properties of hydrophobic silica aerogels. According to Klute "there exists a tremendous opportunity to make a positive improvement of amputee comfort by moving heat and sweat away from the surface of the residual limb".5

POTENTIAL APPLICATIONS

There is a constant flow of new, innovative advancements in the world of prosthetic care, especially in the form of prosthetic liners. Just recently, the publication *The O&P EDGE* outlined a wide variety of new developments in prosthetic liners ranging from temperature control and liner slippage to liner selection and self-repair.9 While developments in the area of temperature control would definitely contribute to the control of the moisture environment at the skin-liner interface, it does not directly address the issue. The research proposed here is innovative in the shear fact that it will be looking into explicitly finding a way to manage this moisture and remove it from the interface. This research has an additional level of innovation due to its utilization of silica aerogels to try to combat the moisture accumulation at the interface. This would be the first time that aerogels have made their way into prosthetic care.

ABSTRACT (CONTINUED FROM PAGE 1)

project is currently on hold until addiaional funding is obtained for application testing at the VA Hospital in Tampa.

ANTICIPATED BENEFITS

To other government agencies: (CONT'D)

the co-principal investigator Dr. Sam Phillips (Samuel.Phillips@va.gov).

Current statistics regarding US military casualties in Operations Enduring Freedom, New Dawn, and Iraqi Freedom indicates that there was a grand total of 1,715 amputations as of December 3, 2012 with approximately 87% of those amputations being a major limb such as a leg.8 It is evident that state-of-the-art prosthetic care is needed to ensure our soldiers can resume a high functioning, normal life upon returning from the battle fields. Servicemembers with amputation are pushing the limits of existing technologies. By developing a new prosthetic liner that has the capability of allowing moisture to be wicked away from the residual skin, we can ensure that we minimize the dermatological issues that are often seen in many amputees. These liners, once developed, will have immediate use by amputees and be able to provide relief from skin ailments instantly. Upon continued use, these liners would be able to control the moisture from the residual skin on a daily basis and provide prolonged relief to the amputee, thereby increasing their ability to maintain a high functioning, high quality of life. These improvements would be particularly useful in the current fields of engagement where hot conditions often persist.

To the nation:

This technology would have a significant impact on the lives of astronauts and disabled veterans, as well as any American with a prosthetic.