High Tortuosity Carbon Dioxide Conversion Device for CO2 Reduction into useful products for Life Support Systems

Technology Need

Chemical reduction of CO2 is a needed function for Life Support during long term space travel. Such processes can create useful products such as oxygen, hydrocarbon fuels, and polymer feedstocks.

Description

The approach involves a 3D manufacturing technology that will incorporate multiple material characteristics. Processes for chemical reduction of CO_2 recycles oxygen and can create other useful products such as hydrocarbon fuels or polymer feedstocks. This can be accomplished by either chemical or biological (synthetic biological microbial) means, and also has widespread terrestrial applicability for carbon sequestration.

Infusion

The technology received seed funding from the Center Innovation Fund. The NASA Innovative Advanced Concepts (NIAC) program subsequently awarded phase 1 funding and is reviewing a proposal to provide phase 2 funding.

Solution

The project demonstrated advantages of an origami type design which allows for both storability and deployability. Photonic energy control with acrylic waveguide and transparent origami structures was performed. Deposition of photocatalytic materials was tested. The team examined flow visualization of tortuosity pathways, and down selected reactor configurations by analysis of integration issues.

Figure 1 Thin film catalyst deposition apparatus. Left to right: Langmiur Blodgett, nanojet printer, plasma jet printer

Benefit

This technology will benefit future crewed exploration missions beyond earth orbit. The concept has the potential to greatly increase the reliability and decrease the mass compared to carbon dioxide sorption/compression/ reduction technology currently used on NASA crewed missions. It is applicable to In Situ Resource Utilization using the Martian atmosphere. In addition, it could be used by the Department of Energy for carbon sequestration devices.

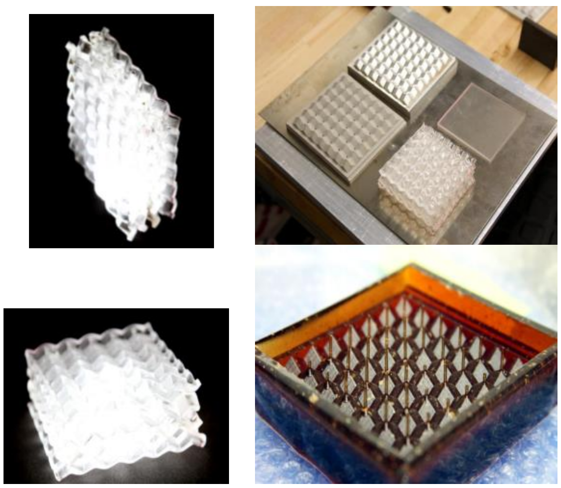

Figure 2 Tortuosity substrates produced with waveguide sheets

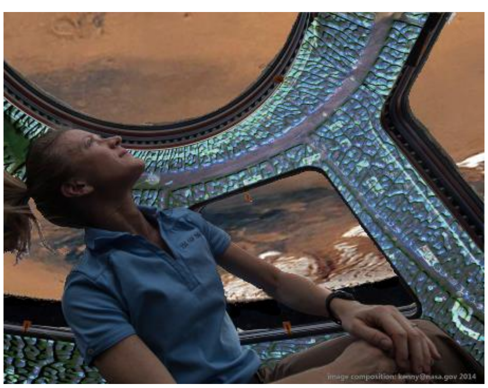

Figure 3 Advanced application of tortuous substrates incorporated into walls.

Development Team Leads

Prof. Bin Chen works on ultra sensitive detection techniques and materials synthesis and applications for sustainable energy. Prof. Chen has conducted over $3 million dollars' worth of federal projects (NASA, DARPA and DTRA) on materials studies and device fabrications in the past five years. She won the recognition of IEEE Bay Area Nanotechnology consult. Prof. Chen has been profiled in both Dekker Encyclopedia of Nanoscience and Nanotechnology and Marquis' Who's Who in America. She has Ph.D. in Chemistry from Pennsylvania State.

Dr. Darrell Jan has a Ph.D. from the Massachusetts Institute of Technology in physiological fluid mechanics. He is highly experienced in air monitoring and air processing.

Dr. Kenneth Cheung is an expert in digital materials, digital fabrication, and rapid prototyping. His Ph.D. is from the Massachusetts Institute of Technology.

Dr. John Hogan is an acknowledged expert in regenerable life support for human space travel and habitation. He received his Ph.D. from Rutgers University in Environmental Science.

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