NASA SBIR/STTR Technologies

NASA Contract #: NNJ08JA62C, Selective Photo-Initiated Electrophoretic Separator (SPIES)

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Identification and Significance of Innovation

To address the NASA need for gas separation and collection technology for lunar in-situ resource utilization (ISRU), Physical Optics Corporation (POC) designed, fabricated, demonstrated, and tested a new Selective Photo-Initiated Electrophoretic Separator (SPIES) System for desulfurization of hydrogen product stream. The Phase II prototype was optimized to scrub hydrogen sulfide in hydrogen gas stream. It can process a 0.83 atm gas stream consisting of 80% hydrogen and has a desulfurization efficiency of ~20%, while consuming <30 W. The H_2 from the photodissociation of H_2S remains in the gas stream, thus eliminating any parasitic loss of H_2 in the hydrogen reduction process.

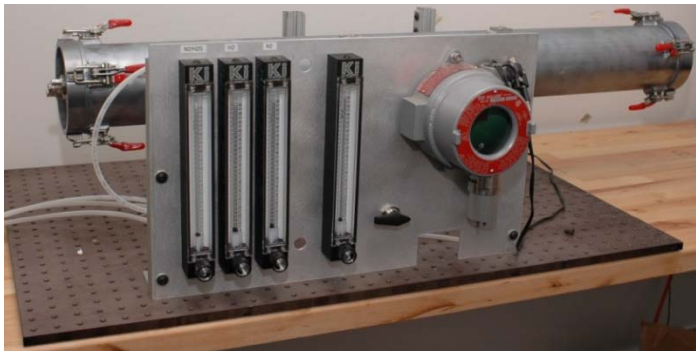
Technical Objectives

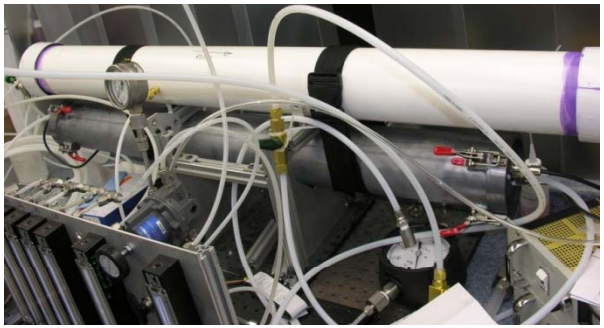
1. Design optimization of the SPIES system to meet NASA lunar ISRU needs for purifying HRP gas streams, and for separating gas species and lunar volatiles in lunar ISRU processes.
2. Development of an empirical model of the SPIES process.
3. Development of the SPIES chamber.
4. Development of the sulfur extractor
5. Integration and packaging of the optimized SPIES prototype system.
6. Testing of the prototype and performance demonstration to NASA personnel.
7. Identification of commercial potential of the SPIES system.

Work Plan

1. Optimize Design, and Refine SPIES System
2. Develop Simulated Hydrogen Reduction Process Gas Stream
3. Develop Optimum SPIES components
4. Perform Analytical, Experimental, and Parametric Study of the SPIES Process
5. Fabricate Test Chambers
6. Develop a Numerical Model of SPIES Process
7. Develop an Optimum SPIES Chamber
8. Develop Gas Separator
9. Assemble SPIES Prototype System
10. Perform Parametric Testing of the SPIES System
11. Conduct Scalability Study
12. Demonstrate Performance of the SPIES Prototype System
13. Explore Commercial Potential and Product Viability
14. Prepare and Submit Reports

Phase II SPIES Prototype





Phase II prototype retrofitted and configured to operate at <1 atm to scrub hydrogen sulfide in hydrogen product stream.

NASA and Non-NASA Applications

The elegance and simplicity of SPIES allows it to be easily integrated into a hydrogen generation plant. It can be modified and inserted between the standard desulfurizer and the steam reformer as a gas polishing stage.

Another application of SPIES is for industrial gas clean up, also known as gas scrubber. Many of the emitted gases as by-products in various manufacturing or processing industries have a significant amount of sulfur compounds. SPIES technology can be modified to reduce the amount of sulfur discharged into the atmosphere. This approach has a huge advantage in terms of cost-saving since no chemical consumable is used.

NON-PROPRIETARY DATA