PROJECT SUMMARY

In response to the NASA In-Situ Resource Utilization (ISRU) need for lunar volatile separation and collection technologies, Physical Optics Corporation (POC) developed in Phase II the new **Selective Photo-Initiated Electrophoretic Separator (SPIES)** based on photolysis and electro-separation of selected species. To meet the specific need of Johnson Space Center (JSC) to eliminate hydrogen sulfide (H_2S) in a hydrogen reduction process (HRP) product stream used to extract oxygen from lunar regolith for human consumption, POC designed, analyzed, fabricated, and tested two generations of SPIES prototypes. These prototypes use a compact, energy-efficient excimer lamp to selectively photodissociate H_2S, and a low-power-consuming high-voltage electroprecipitator to extract the dissociated sulfur compounds from the HRP product stream. In addition, SPIES reduces H_2S without the use of a membrane that requires regeneration or replacement. This development led to the demonstration of a proof-of-concept SPIES prototype.

The specific Phase II efforts and accomplishments include: designed and fabricated two generations of SPIES prototypes to improve upon the Phase I design; identified and verified H_2S photodissociation dependency on wavelength; identified the optimal optical source for photodissociation; developed an empirical analytical model of the photodissociation process; optimized electrode configurations for maximum desulfurization and sulfur precipitation; conducted fluid mechanic simulation to identify the optimum prototype design and flow rates; and performed parametric tests to determine the optimal operating condition. The cumulative results of these accomplishments led to the design, fabrication, and testing of the Phase II 2nd generation SPIES prototype. It can process a 0.83 atm gas stream consisting of 80% hydrogen and has a desulfurization efficiency of 20%. This prototype can maintain a plug flow profile with a flow rate $\geq$ 3 lpm and consumes <30 W. The H_2 from the photodissociation of H_2S remains in the gas stream, thus eliminating any loss (parasitic loss) of H_2 in the SPIES process.