**Carbothermal Reduction Demonstration: Laser Driven Reaction in a Thermal-Vacuum Environment and Project Status.** A. J. Paz, NASA Johnson Space Center (2101 NASA Parkway, Houston TX 77058; Aaron.Paz-1@nasa.gov)

**Introduction:** Lunar regolith is approximately 45% oxygen by mass. The majority of the oxygen is bound in silicate minerals. The carbothermal reduction process has been proven to be effective at removing oxygen from lunar regolith simulants [1]. The Carbothermal Reduction Demonstration (CaRD) project aims to increase the Technology Readiness Level (TRL) of a combined solar concentrator and carbothermal reduction system in order to demonstrate this technology on the lunar surface. The CaRD project is divided into two design cycles, a brassboard and prototype. The status of both design cycles will be discussed, as well as concepts for how this technology can be applied to the Artemis program in the future.

**Brassboard Vacuum Test:** For the brassboard demonstration, a 2 kW Nd-YAG laser was used to heat lunar regolith simulant within a carbothermal reactor developed by Sierra Space. The reactor was placed inside of a 15ft thermal vacuum chamber at the Johnson Space Center. The resulting reaction products were analyzed using both a gas chromotograph and mass spectrometer provided by Kennedy Space Center.Thermal data was also collected.

**Prototype Design:** For the prototype, the CaRD team will perform another thermal vacuum test at JSC using the same interfaces and assets developed for the brassboard, but will test a new carbothermal reactor design that Sierra Space is developing through the Carbothermal Oxygen Production Reactor (COPR) Tipping Point project that will include a means to autonomously move regolith in and out of the reactor. In addition, a deployable solar concentrator is being developed by Glenn Research Center using mirrors produced by Carbon Mirror Applications. The solar concentrator will be used to deliver solar energy into a carbothermal reactor to melt regolith and extract oxygen. Avionics and software for the concentrator are being developed by Kennedy Space Center.

**Future Concepts**: An ongoing task within the CaRD project is to update models that can be used to determine the mass, power, and size of In-Situ Resource Utilization concepts at various scales. These models can now be used to analyze alternatives for future applications based on the latest available data.

**References:**

[1] Gustafson, R., White, B., & Fidler, M. (2011). 2010 field demonstration of the solar carbothermal regolith reduction process to produce oxygen. In *49th AIAA Aerospace Sciences Meeting including the New Horizons Forum and Aerospace Exposition* (p. 434).