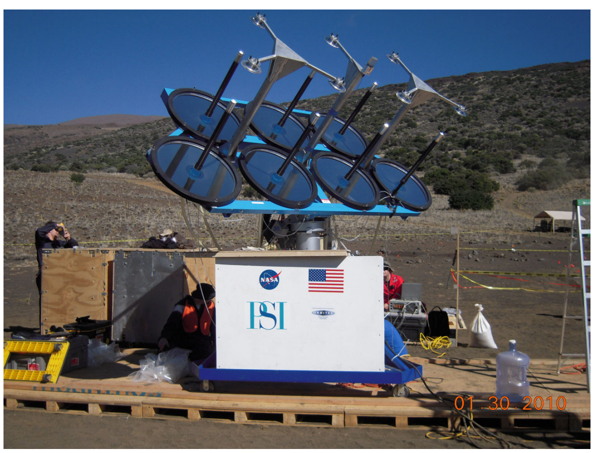
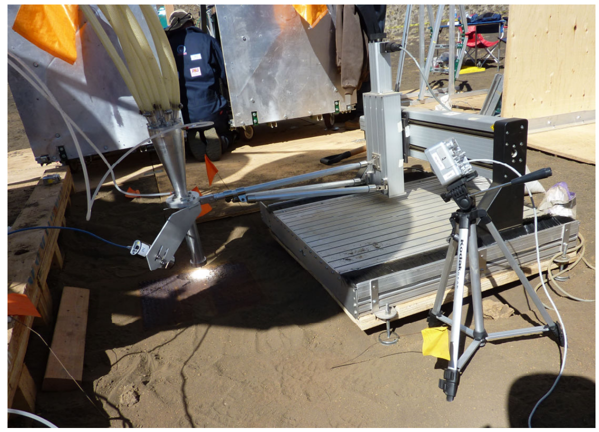
RESULTS OF SOLAR SINTERING EXPERIMENT WITH MULTIPURPOSE SOLAR THERMAL WAVEGUIDE SYSTEM. B. K. Smith[1], T. Nakamura[2], R. Theiss[3], and D. Boucher[4], [1] Physical Sciences, Inc. (6652 Owens Dr, Pleasanton, CA 94588, smith@psicorp.com), [2] Physical Sciences, Inc. (6652 Owens Dr, Pleasanton, CA 94588, nakamura@psicorp.com), [3]Northern Centre for Advanced Technology, Inc. (1545 Maley Dr., Sudbury, ON, Canada P3A 4R7. rtheiss@norcat.com) [4]Northern Centre for Advanced Technology, Inc. (1545 Maley Dr., Sudbury, ON, Canada P3A 4R7. dboucher@norcat.com)

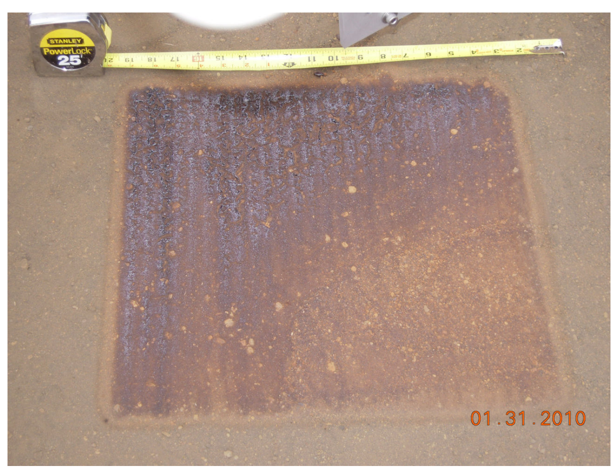
Introduction: Physical Sciences, Inc (PSI), in collaboration with the Northern Centre for Advanced Technologies (Norcat), successfully demonstrated the use of the multipurpose solar thermal waveguide system for sintering lunar stimulant during the NASA field test in Mauna Kea, HI, in January, 2010. The solar thermal waveguide system, developed by PSI, with funding support from NASA Glenn Research Center and NASA Johnson Space Center[1], focuses solar energy and directs it through a low-loss optical fiber cable onto the lunar stimulant surface. The output power from the optical waveguide cable was directed to the Tephra surface by an X-Y-Z motion stage developed by Norcat. Temperatures exceeding 1300˚C were achieved, and both sintering and melting of material were observed.



Equipment: The PSI solar concentrator uses seven mirrors, each focusing onto a single optical waveguide cable. The seven cables are combined into a single quartz rod, which focuses the light from the cables onto the surface. The cable outlet assembly is bolted to the X-Y-Z stage, which moves the quartz rod at predetermined rates over the surface, to provide regular heating over a large area. The Norcat X-Y-Z stage was programmed to move in specific patterns at specific speeds. The surface temperature of the lunar regolith simulant was measured by a one-color optical pyrometer. The stimulant used was native Hawaiian tephra, which had been raked and leveled.



Results: Temperatures as high as 1300˚C were achieved, with output power up to 560W. The optimum temperature for sintering the native tephra was found to be approximately 1075-1125˚C. Fluctuations in the direct solar flux made clear that a feedback system based on surface temperature measurements would be required for ideal heating when operating in changeable weather conditions. Surface temperature was also sensitive to the distance from the output quartz rod and the ground, as well as the presence of rocks in the stimulant. The stimulant was successfully sintered to a depth of approximately 1mm.



References:

[1] Nakamura, T. (2007) 48th AIAA Aerospace Sciences Meeting, 2010-1162.