SELF-PROPAGATING CHEMICAL REACTIONS FOR MAKING MATERIALS AND STRUCTURES FROM LUNAR AND MARTIAN REGOLITH.

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Use of regolith for *in situ* production of construction materials would decrease the amount of materials transported from Earth in missions to the Moon and Mars. One promising approach involves mixing regolith with energetic additives that can react either between each other or with the regolith, leading to the formation of ceramic materials. Studies on combustion of lunar and Martian regolith simulants with magnesium were conducted at the University of Texas at El Paso (UTEP) [1-5]. This research included thermodynamic calculations, combustion experiments at normal and reduced gravity, and thermoanalytical studies of the reaction mechanisms. The results indicate that magnesium is an effective additive that enables a self-sustained combustion of regolith-based mixtures (Fig. 1) through thermite reactions with regolith constituents such as silica and iron oxide.

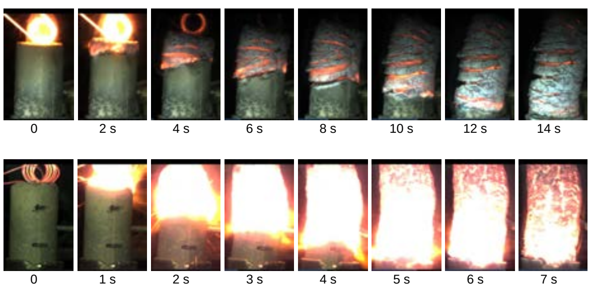

Fig. 1. Combustion propagation over compacted mixtures of (top) Mojave Mars and (bottom) JSC-Mars-1A regolith simulants with magnesium (20 wt% Mg). Time zero was selected arbitrarily.

Another approach involves sintering lunar or Martian regolith followed by combustion joining of the obtained ceramic parts. Recently, a robust technique has been developed at the NASA Kennedy Space Center for sintering regolith into ceramic tiles that could be used for building launch/landing pads on the surface of the Moon or Mars with the goal of mitigating dust problems. Experimental and modeling studies have been conducted at UTEP to investigate the use of self-propagating intermetallic reactions for joining the regolith tiles. A mixture of aluminum and nickel was placed into a gap between two tiles and ignited with a CO_2 laser, leading to a self-sustained propagation of exothermic aluminum-nickel reaction. Figure 2 shows two tiles joined together as a result of this process. The obtained dependences of the combustion front velocity and the maximum temperature on the distance between the tiles were compared with modeling predictions.

Fig. 2. Two ceramic tiles made of JSC-1A lunar regolith simulant and joined by combustion of aluminum/nickel mixture placed between them and ignited with a laser.

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