Getting Water from the Water of Hydration on Mars

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Both Viking landers found evidence of water in small concentration (< 1%) in the soils of Mars. Using the gas chromatograph mass spectrometer the soil samples on Mars were heated to 500°C to release the water. This result lead researchers to believe that the water in the soil of Mars was tightly bound in a hydration state. In the laboratory we have run several Mars analog soils and a few bench mark soils through a microwave to determine the amount of water released using this method. The results suggest that sufficient water can be obtained using this method to augment the activities of a human base on Mars. Using microwaves to obtain the water instead of a convection oven has many advantages. First the microwave energy is tuned to the water molecules, therefore converting more of the energy into releasing the water. Second, microwaves can be used in the near vacuum of Mars without pressurizing a chamber, unlike ovens which need a convection medium to work properly.

Chemical Approaches to Carbon Dioxide Utilization for Manned Mars Missions

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Utilization of resources available *in situ* is a critical enabling technology for permanent human presence in space. A permanent presence on Mars, for example, requires a tremendous infrastructure to sustain life under hostile conditions (low oxygen partial pressure, ultraviolet radiation, low temperature, etc.). There are numerous studies on the most accessible of Martian resources: atmospheric carbon dioxide. As a resource on Mars, atmospheric CO_2 is: (1) abundant, (2) available at all points on the surface, (3) of known presence, requiring no precursor mission to verify, (4) chemically simple, and (5) can be obtained by simple compression, with no requirements of mining or beneficiation equipment operation. Many studies focus on obtaining oxygen and the various uses for oxygen including life support and fuel; discussion of carbon monoxide, the co-product from CO_2 fixation revolves around its use as a fuel, being oxidized back to CO_2. This study examines several novel proposals for CO_2 fixation through chemical, photochemical, and photoelectrochemical means. For example, the reduction of CO_2 to acetylene (C_2H_2) can be accomplished with hydrogen. Acetylene has a theoretical vacuum specific impulse of ≈375 seconds. Acetylene is a gas at room temperature, but has a boiling point of -75°C, making it easier to store than methane. We also examine potential uses of CO, as obtained or further reduced to carbon, as a reducing agent in metal oxide processing to form metals or metal carbides. The metal or semimetals and carbides can then be used as structural or power materials; the CO_2 can be recycled to generate O_2 and CO.