Purifying Water Mined from Asteroids for In Situ Resource Utilization

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Near-earth asteroids have been identified as sources of not only precious raw metals, but also water. Water is a crucial resource for human development of space. The ability to generate propellants and life support consumables from available water and other in-situ resources is vital to any mission success that does not solely rely on carrying supplies from Earth. Water mined from asteroids can be electrolyzed into oxygen and hydrogen and used to supply fuel depots in space. However, extracting the water may not be a straightforward process. The water found on near-earth asteroids is in the form of hydrated silicates. The water must be released via thermal decomposition of the hydrated silicates at around 600 to 800°C, depending on the mineralogy. During this process other minerals, such as carbonates, sulfates, sulfides, and chlorides, present in the regolith are likely to decompose and volatilize, contaminating the vapor stream. These volatiles need to be separated from the water vapor to avoid damaging downstream processing equipment, such as electrolysis cells. A water clean-up system is key to the implementation of asteroid water mining. An ionomer-membrane based Contaminant Robust In-situ Water Extractor (CRIWE) is currently being developed to clean water for in-situ processing. A system architecture employing CRIWE technology for asteroid water mining is explored in the context of water electrolysis. Preliminary test results of CRIWE technology as implemented in other environments are also presented.

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