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MICROWAVE POWERED EXTRACTION OF WATER ICE FROM THE PERMANENTLY SHADOWED REGIONS ON THE LUNAR SURFACE

Abstract

The future of space exploration is highly dependent on In-Situ Resource Utilisation technologies which will harness the resources that are readily available on the planetary bodies for keeping their respective space settlements sustainable and independent from Earth. Moon is a place of high focus for developing a human settlement as it lies between Earth and Mars and has useful resources like water which can be used for multiple applications like production of oxygen for the crew, production of hydrogen for fuel cell-powered machines, etc. This paper will discuss a special technique developed to extract water trapped inside the lunar regolith located in the moon's polar craters as discovered by the previous moon missions. In this method, microwaves will penetrate through the top regolith layers and heat the water ice trapped inside it. This will lead to the sublimation of water molecules through the top regolith surface along with any other volatiles present there. A mechanism is designed to collect these vapors into a special cold trap where it would turn into a solid block that will be separated from the regolith. It can then be taken back to the base or production facility and processed further according to requirements. Regolith acts as a natural insulator and will not readily transfer heat via conduction. Therefore, other heating techniques like solar heating directed using lenses and mirrors, electric heating, etc. decrease the efficiency of our system. Microwaves on the other hand have higher penetrating power with lower energy consumption compared to the aforementioned techniques and it also keeps the entire process dustless which is very useful for keeping the onboard machine components safe from the fine and sharp lunar dust particles. This technology can be easily adapted for any size or capacity according to the mission requirements. This paper will validate the aforementioned concepts with the help of currently available lunar surface data as well as explain the scope of this technology.