

Regolith thermal energy storage for lunar nighttime power

How does a lunar regolith thermal storage power generation system work?

A lunar regolith thermal storage power generation system is modeled and analyzed. The designed system has a specific power of 6.5 W/kg during the lunar nighttime. The heat loss of Fresnel collector takes 37.1% of the total collected solar energy. The total conversion efficiency of designed power generation system reaches 19.6%.

Can lunar regolith heat storage be used for solar energy?

In general, it is technically feasible to develop a solar thermal power system with lunar regolith heat storage on the Moon. However, owing to the long alternation of day and night on the Moon, making full use of lunar regolith heat storage to build a continuous and efficient energy system for the lunar base remains a problem.

Can a solar thermal storage system based on lunar in-situ resources utilization?

A solar thermal storage power generation system based on lunar in-situ resources utilization: Modeling and analysis. Energy, 2021, 223: 120083 Barna G J, Johnson, Johnson R L. Investigation of the use of the lunar surface layer to store energy for generating power during the lunar night.

What is a solar thermal storage system based on lunar ISRU?

The lunar regolith solar thermal storage power generation system based on lunar ISRU is a promising solution of energy supply challenge for long term lunar exploration. The average output power of the designed system can reach 6.5 kW, and the total photoelectric conversion efficiency of the system is 19.6%.

What is a linear Fresnel collector and a lunar regolith thermal energy reservoir?

The linear Fresnel collector and the lunar regolith thermal energy reservoir are designed in detail. A theoretical model is developed using the finite-time thermodynamics method, and the major irreversibilities are taken into account. The energy flow and heat loss of the system are analyzed, and the specific power of the system is evaluated.

How to analyze the performance of the power generation system using processed lunar regolith?

In order to analyze the performance of the power generation system using processed lunar regolith as thermal energy storage materials, the default parameter values including the thermophysical properties of the processed lunar regolith and the parameters of the Stirling generator listed in Table 1 are used in our simulations. Table 1.

using Lunar regolith to store and slowly release thermal energy to survive the Lunar night. Lunar regolith in vacuum is a highly insulative material, with a heat transfer coefficient of under 1.5×10^{-4} W/cm² K even when fully densified [1]. To make use ...

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Thermal Wadis [7], [8] are engineered sources of stored solar energy which use modified lunar regolith as a thermal storage mass (Fig. 1). ... The lunar base heat storage system is one of the best solutions because it is possible to transfer energy from day to night for power generation. However, due to the diversity of energy demands of the ...

The lunar heat storage system is the key equipment to maintain continuous day and night power generation. Owing to the different stages of lunar base construction, the requirements for lunar base heat storage system are different. ... Regolith thermal energy storage for lunar nighttime power. AIAA/NASA/OAI Conf Adv SEI Technol 1991 (1991), 10. ...

The concept of using lunar regolith as a thermal energy storage medium was evaluated. The concept was examined by mathematically modeling the absorption and transfer of heat by the lunar regolith. Regolith thermal and physical properties were established through various sources as functions of temperature. Two cases were considered: a semi-infinite, ...

lunar outposts. Since the night lasts for periods of about 350 h at most locations on the lunar surface, massive energy storage is required for continuous energy supply during the lengthy lunar night and the in-situ resource utilization is demanded. A lunar based solar thermal power system with regolith thermal storage is presented in this paper.

Accordingly, the idea has been proposed to use lunar regolith for thermal energy storage and electrical power generation [9], [10]. ... The analysis shows that the temperature of the regolith thermal reservoir can be maintained high enough during lunar day-night cycles for power conversion. For an in-situ lunar regolith with high solar ...

As a kind of in-situ resource utilization, the regolith thermal energy storage is a promising way to solve the energy crisis of manmade moon base during the long lunar nighttime of 350 h. In this paper, a lunar regolith thermal storage system is designed and two different stacking methods of lunar regolith spheres are proposed, the thermal ...

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However, limitations in the utilization of the thermal storage unit lead to poor power generation capabilities during the lunar day. Xie [32] et al. proposed the conception of lunar in-situ energy support technology that exploits the significant temperature difference between the interior and surface of the lunar regolith for power generation ...

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In-Situ Resource Utilization (ISRU) technologies for future deep-space exploration is a current hot topic considering planned lunar missions for the coming years. Energy generation and storage using regolith can be useful not only for future lunar human outposts but also to assist lunar mining or construction activities during the lunar night. Here we explore the design of a ...

Analysis of Lunar Regolith Thermal Energy Storage Anthony J. Colozza Sverdrup Technology, Inc. Lewis Research Center Group Brook Park, Ohio November 199 ... during the daytime to allow for continuous power production throughout the night. Energy would be stored and recovered by circulating a fluid through a heat transfer device in contact with ...

Regolith thermal energy storage for lunar nighttime power. B. Tillotson. Engineering, Physics. 1991; A scheme for providing nighttime electric power to a lunar base is described. This scheme stores thermal energy in a pile of regolith. Any such scheme must somehow improve on the poor thermal ...

Analysis of lunar regolith thermal energy storage ... 1968 "Investigation of the use of the Lunar Surface Layer to Store Energy for Generating Power During the Lunar Night," NASA T M X-1560. Crane, R.A. and Dustin, M.O., 1991, "Solar Dynamic Power/ Process Heat Generation for the Proposed Lunar Oxygen Production Plant," NASA Lewis ...

79 Thermal wadis are engineered solar energy storage systems that use modified regolith as a thermal storage mass [7]. Wadis can store heat during the 81 lunar day, and supply heat during the lunar night to rovers. They are good 82 candidates to provide the required thermal energy for the survival of rovers

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A scheme for providing nighttime electric power to a lunar base is described. This scheme stores thermal energy in a pile of regolith. Any such scheme must somehow improve on the poor thermal conductivity of lunar regolith in vacuum.

Thermal Energy Storage Construction. Planetary Surface Construction Tasks ... o Extended lunar night time operation and power storage o Thermal management ... Lunar Master Site Planning Considerations: Example Mueller & King, 2007. Lunar Base Construction Build Regolith Based Landing Pads and Berms for safe Vertical Take Off & Vertical ...

Systems such as Thermal Wadi [5,6] were analyzed for night heating of rovers and Thermal Energy Storage (TES) [7] for generating electricity for the needs of a manned outpost. An important advantage of these energy storage systems is the possibility to create thermal masses from modified lunar regolith. Modifications

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such as compression,

REGOLITH THERMAL ENERGY STORAGE FOR LUNAR NIGHT-TIME POWER Brian Tillotson Boeing Defense & Space Group Abstract A scheme for providing nighttime electric power to a lunar base is described. This scheme stores thermal energy in a pile of regolith. Any such scheme must somehow improve on the poor thermal conductivity of lunar regolith in vacuum.

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