Electric Power Development on the Moon from In-Situ Lunar Resources

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Abstract: The long-term exploration and colonization of the solar system for scientific research and commercial interests depends critically on the availability of electrical energy. In addition, the long-term potential for humans to settle space requires self-sufficiency, and therefore, self-sustaining electrical power systems. This can be attained on the Moon by utilizing the indigenous resources present there through the fabrication of solar cells using thin film growth technology and the vacuum environment of the Moon. Thin film solar cells will be fabricated directly on the surface of the Moon through the transport to the Moon of only the tools needed to fabricate the cells and not the transport of the vast arrays of cells themselves. The solar cells will then be grown by thin film vacuum deposition on the prepared regolith of the lunar surface. This will be undertaken by the deployment of a ~200kg crawler on the surface of the Moon with the capabilities of initial preparation of the lunar regolith by local melting under concentrated solar irradiation for use as a substrate. This is followed by evaporation of the appropriate semiconductor material for the solar cell structure, and then vacuum deposition of metallic contacts and interconnects thus fully comprising continuous layout of solar cells on the lunar surface. This design will allow for the emplacement of a lunar electric power system that can reach 1 MW in several years of crawler operation. Initial growth of the thin film solar cells will proceed with raw materials brought from Earth. These first cells can be made more directly by fabrication from CdS/CdSe (as compared to silicon). With an initial installation of ~100 kW capacity (6 months of operation) a second facility, a Regolith Processing Facility, can then be emplaced on the Moon which will extract the needed raw materials from lunar regolith so as to feed the solar cell crawler for the fabrication of silicon solar cells by using the electrical power generated by the initial cell fabrication. This unique approach for the emplacement of an electric power system on the Moon would require the transportation of a much smaller mass of equipment to the Moon than would otherwise be required to install a power system brought to the Moon, and would result in a power system that was repairable/replaceable through the simple fabrication of more solar cells.