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SPACE POWER SYMPOSIUM (C3)
Wireless Power Transmission Technologies, Experiments and Demonstrations (2)

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SPACE DEMONSTRATION EXPERIMENT ON INTERACTION BETWEEN HIGH POWER MICROWAVE AND IONOSPHERIC PLASMA USING SMALL SCIENTIFIC SATELLITE FOR SOLAR POWER SATELLITE

Abstract

Solar power satellite (SPS) has been studied and developed as a promising energy system that provides a solution to the environmental and resource problems. Wireless power transmission (WPT) from space to the ground is inherent technology of the SPS. Some WPT demonstrations on the ground and in space have been performed in Japan. Two rocket experiments, MINIX in 1983 and ISY-METS in 1993 were performed by Kyoto University and ISAS in order to study nonlinear interactions of the high power microwave in the space plasma environment. However higher-accuracy evaluation of the effect of the microwave against the ionospheric region are required because the experiments of the sounding rocket are limited in time and mass resources. Microwaves interact with ionospheric plasma. Plasma density gradient and its variation will results the phase shift of the microwave and degradation of the accuracy of the microwave beam pointing. Also, injection of the high power microwave into plasma will cause a change in plasma distribution of ionospheric region or a plasma hole that will affect on communications. Plasma heating by the microwave will cause a decreasing of the plasma density and thermal self focusing of the microwave beam. There is a possibility that several non-linear interactions in the ionosphere, which include parametric instability excitation, electron thermal runaway in the lower ionosphere and thermal self-focusing of the microwave beam by the poderomotive force, are excited by microwaves. Microwave power density around ionospheric region is designed around several hundred W/m2 for the future commercial base SPS. These effects should be confirmed by the space experiments. We are considering a space experiment on the WPT from space to the ground and on the interaction between high power microwave and ionospheric plasma using a small scientific satellite. The total microwave power radiated from the power transmission panel is 0.95 kW for a single antenna panel configuration. This level of microwave power injection will generate a power density above 1000 W/m2 within 50 m, and 100 W/m2 within 100 m in the ionosphere. Effects of interaction between high power microwaves and plasma in ionosphere can be measured. We would like to present a mission configuration and measurement methods on the interaction between the high power microwave and the ionospheric plasma.