

SPACE PROPULSION SYMPOSIUM (C4)
Advanced and Combined Propulsion Systems (8)

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DEVELOPMENTS OF MICROWAVE ROCKET AS A FUTURE LOW-COST MASS
TRANSPORTATION SYSTEM**Abstract**

Microwave Rocket is a candidate of future low-cost launchers to the space. Propulsive energy is repetitively supplied by pulsed millimeter wave beams irradiated from the ground and the atmospheric air is used as a propellant, so that the amount of propellant on board can be much lighter than that of chemical propulsion systems, which results in higher payload ratio. In addition, no complex systems are required in this system due to a pulsed detonation engine with electromagnetic wave. Thus the system can be reliable, which leads a low manufacturing cost. Moreover, beamed energy source as a key device can be set on the ground, which means the core system can be used repetitively and its maintenance can be easy with a low cost. For these reasons, Microwave Rocket is thought as a future low-cost mass transportation system for construction of huge infrastructure like Space Solar Power System. Microwave Rocket consists of a reflector to ignite and a cylindrical tube to keep high pressure inside. The closed end of the cylindrical tube has a beam-focusing reflector called "thrust wall" and the other end serves as an entrance for the millimeter wave beam, from which also air is exhausted and refilled after the end of a thrust generation cycle. The objective of this paper is to show recent developments of a Microwave Rocket including a new thrust record of 30N by a single gyrotron of 91kW at an averaged power. 170GHz gyrotron at JAEA was applied to a millimeter wave beam generator. Experiments were done in a condition of 570kW power at the top with 200Hz repetition, in other word 0.16 duty ratio. Thrust impulse was measured by a pendulum thrust stand with a fast-sampling laser displacement sensor. As a result, 30N

thrust was obtained by a single gyrotron of 91kW at an averaged power. This result shows 330N/MW of a thrust to power ratio, therefore, kilogram-weight thruster can be lifted up by a gyrotron. Next target of our demonstration flight is to launch 4kg model rocket up to 10m altitude with a long-range beam transmission mirror system and a single gyrotron.