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Study on Pulse-driven Phase Controlled Magnetron

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The object of the present study is to develop a pulse-driven PCM(Phase Controlled Magnetron). A PCM has been originally developed for a microwave source of a microwave power transmission system. The pulse-driven PCM for radar systems has a possibility for an additional application. Also, a key feature of the pulse-driven PCM is adjustment of the output microwave power by pulse width control. Compared to semiconductor devices, a PCM is efficient, inexpensive and light. However the previous PCMs are driven in CW mode and they need three second to control the phase. Therefore, the response time of the PCMs is necessary to be improved to develop a pulse-driven PCM and high-speed beam directional control for a microwave power transmission system.

The PCM developed by our study group can stabilize its phase and its oscillating frequency by combination of the injection locking method and controlling anode current of the magnetron with a PLL(Phase-Locked Loop) technique.

First, we experimentally succeeded in a high-power microwave beam forming with SPORTS2.45 (Space POwer Radio Transmission System for 2.45GHz). We also analyzed the effect of phase fluctuation on microwave beam pattern.

Next, we optimized a PLL system of the previous PCM. Response time of the optimized PCM is about 1.6ms. Furthermore, we designed a new phase control system for a high voltage power supply with quick response time and succeeded in speed-up of the phase control system. As the result, the response time is improved to be about 0.2ms.

Finally, we developed a kHz-class pulse-driven PCM by the improved PCM. The pulse-driven PCM was able to stabilize its phase within 0.1ms in most pulses. Furthermore, we suggested a MHz-class PCM control system, which is designed with a standard weather radar system.