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Performance of a Low Impedance Nanosecond Pulse Generator

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A nanosecond pulse generator (NS-PG) which can generate high voltage pulses with duration of 5 ns and fast rise and fall times of 2 ns enables higher energy efficiencies of plasma processing. To enable development of a high-power generator for high processing capacity in the applications such as ozone generation and exhaust gas treatment, a low impedance NS-PG with higher output current was investigated.
The NS-PG consists of a microsecond-pulse generation circuit as a charging unit, and a nanosecond pulse forming line based on a Blumlein line configuration. This study focused on the nanosecond pulse forming line, consisting of a spark gap switch (SGS) as a self-closing switch, a triaxial Blumlein line as a pulse forming line, and a transmission line from the Blumlein line to load. SF6 gas filled the SGS, and the output voltage of the generator was regulated by varying the pressure of the gas. The Blumlein and transmission lines were filled with silicone oil; which changed with ethylene glycol in this study to reduce characteristic impedance of the NS-PG. In addition, the length of the Blumlein line and the structure of the SGS were also varied to improve the performance of the low impedance NS-PG.
This paper presents both the performance of several types of NS-PGs made in the development process of the low impedance NS-PG and switching performance of the new low inductance SGS. All of experiments carried out using a matched register as load for each generator. Results show that peak current of the low impedance NS-PG with the new SGS was 3 times higher than that of the previous NS-PG; also, the new SGS showed different switching characteristics from the conventional one in both pressure and frequency characteristics.

Author: SHIMOTSU, Ryusei (Kumamoto)

Co-authors: Dr NAMIHIRA, Takao (Institute of Pulsed Power Science, Kumamoto University); Dr WANG, Douyan (Institute of Pulsed Power Science, Kumamoto University)

Presenter: SHIMOTSU, Ryusei (Kumamoto)

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