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Study on pulsed-discharge devices with high current rising rate for point spot short-wavelength source in dense plasma observations

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An intense short-wavelength light source generated by a pulsed-power device is an important tool for observing interior of dense plasma, lithography, and so on. For observing interior of dense plasmas by scattering and transmission measurement, we required an intense and point-spot like X-ray source, because of the plasmas characteristics is in dense (10-3ρs-ρs, ρs: solid density), small-size (μm-mm), short-lifetime (several 10ns) and optically thin in X-ray region (>6keV). For this reason, we considered the X-ray point-spot light source generated by X-pinch technique. For this application, a pulse power device with high current rising rate should be developed. The parameters required by the equipment for X-pinch are large current (100kA~), short rise time (~100ns) and high current rising rate of 1012-1013A/s [1-3].

For the development of the light source for observation of the dense plasma, we considered an X-pinch light source based on a pulse forming network (PFN) [4]. At the previous study [5], for the optimum and configurable circuit topology, it was found that the 3 LC-ladder PFN was suitable for the X-pinch light source, and the current rising rate of 1012A/s was obtained by circuit simulation. In addition, we constructed the paralleled 3 LC-ladder PFN, and measured the discharge current waveform. As the experimental result, the current rising rate of 3.4x1011A/s was obtained at 12 paralleled PFN system.

In this study, we considered the configuration for PFN with the circuit simulations, and constructed the pulsed-power device. We obtained experimentally the discharge current of the constructed pulsed-power device, and compared the characteristics for 2-module and 6-module units, where the one module consists of the 3 LC-ladder PFN. Furthermore, we consider the experimental configuration of X-pinch light source based on the paralleled unit of PFN modules.

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