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X-pinch Diagnostic for Warm Dense Matter and Pulsed-power Developments in Nagaoka University of Technology

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Warm dense matter (WDM) is of key interest to understand the fusion developments such as an efficient target structure for inertial fusion and/or the first wall of magnetic fusion. Coupled ions, degenerated electrons and the liquid-vapor phase transition should affect the transport properties and the EOS in WDM state. Evaluating properties in WDM state, we have studied pulsed-power systems for the isochoric heating of foamed metal [1-3] and the intense X-ray system [4].

Features of the isochoric heating of foamed metal [1-3] are possible to produce isochoric condition, use of conventional tamper, avoiding skin effect, and direct spectroscopic measurement. The density of WDM can be controlled by enclosed volume of foamed materials. The discharge systems consist on low inductance gap switch and capacitors (3×1.87 μF) charged up to 15 kV. Observed electrical conductivity and foam/plasma temperature is about 104 S/m and 4000 K in 0.1ρs. The observed electrical conductivity is in agreement with the other experimental results and predictions. The temperature dependence of electrical conductivity is neither metallic nor ideal plasma characteristics.

For the development of the X-ray light source for observation of the dense plasma, we considered an X-pinch light source based on a pulse forming network (PFN) [4]. The current rising rate of X-pinch light source is estimated to be 1012-1013A/s. For the reducing charged voltages and configurable circuit topology, it was found that the modules of 3-stage LC-ladder PFN were suitable for the X-pinch light source, and the current rising rate of 1012A/s was obtained by the circuit simulation. The discharge current waveform of 3-stage LC-ladder PFN was measured. As the experimental result, the current rising rate of 3.4x1011A/s was obtained at 12 paralleled modules of 3-stage LC-ladder PFN. We consider the experimental configuration of X-pinch light source based on the paralleled unit of PFN modules.

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