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Development of Bipolar Pulse Accelerator for High-Purity Intense heavy Ion Beam

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Recently pulsed ion beam technology has been widely used for materials surface properties modification by the methods of ion implantation, ion plasma coatings deposition, and high energy ion beam energetic impact. For those materials processing applications, it is very important to develop the accelerator technology to generate ion beams with various ion species and high purity.
In order to improve the purity of the intense pulsed ion beam, a new type of a pulsed ion beam accelerator named "bipolar pulse accelerator"has been proposed. In order to confirm the principle of the accelerator, a double coaxial type bipolar pulse generator and a prototype of the experimental system were developed. The bipolar pulse generator consists of a Marx generator and a pulse forming line (PFL) with a rail gap switch on its end. The system utilizes a magnetically insulated acceleration gap and was operated with the bipolar pulse. A coaxial gas puff plasma gun was used as an ion source, which was placed inside of the grounded anode. Source plasma was injected into the acceleration gap. When the bipolar pulse with voltage with the first pulse with a voltage of -138 kV and the second pulse with a voltage of +102 kV was applied to the drift tube, the ions were successfully accelerated from the grounded anode to the drift tube in the 1st gap by the negative pulse of the bipolar pulse. The pulsed ion beam with current density of 24 A/cm2 and pulse duration of 50 ns was obtained at 50 mm downstream from the anode surface. The ion energy was in reasonable good agreement with the acceleration voltage, i.e., 1st pulse (negative pulse) voltage of the bipolar pulse. We are doing experiments on the two-stage acceleration of pulsed ion beam in the bipolar pulse accelerator.

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