Production of Oxygen Ions through the Laser Ablation of Alumina

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ABSTRACT

Laser ablation using a solid oxide compound material makes the ion production of gaseous elements possible. Aluminum and alumina targets were used in the laser ion source and was operated for laser power densities 2.0 to 4.3 ×10⁸ W/cm². Ion signals showed the presence of mainly Al, O and C for both aluminum and alumina targets. For the aluminum target, singly charged aluminum ions dominated the ion population in the plasma pulse with other ions and higher charge state aluminum ions stay below 30%. Meanwhile, large amounts of singly charged oxygen and aluminum ions were detected for the alumina target with the current due to the singly charged oxygen ions occupying 60% of the total beam current.

INTRODUCTION

Laser ablation of solid materials have been intensively studied in the fields of materials science and accelerator physics. Multiply charged ions are generated through a simple configuration with plasma parameters dependent on the laser irradiation conditions.

The assumption for the one-dimensional plasma propagation from a point source is described using the relation, \( T \propto L \) and \( I_{ion} \propto L^{-2} \), where \( L \) is the drift length, \( T \) is the ion beam pulse width, and \( I \) for the peak current. This allows the ion energy distributions to be analyzed in temporal profiles and also permit the scaling and estimation of the beam current measurements.

RESULTS AND DISCUSSION

To investigate the oxygen ion production from an alumina laser target, measurements were compared to an aluminum laser target with the same laser irradiation conditions.

The mass separated ions were analyzed through the electrostatic ion analyzer to estimate the charge state distribution in a single plasma pulse.

REFERENCES