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Production of Oxygen Ions through the Laser Ablation of Alumina

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Laser ablation of a solid oxide compound material makes the ion production of gaseous elements possible. Using an aluminum and alumina for the target in the laser ion source, the plasma characteristics in a low laser energy scheme was investigated to understand the difference in ion production of oxygen from the aluminum oxide material. The Faraday cup measurements of the laser produced plasma were measured using the laser power densities of 2.0, 2.9, 3.5 and 4.3 × 10^8 W/ cm^2 and the ions examined through an electrostatic ion analyzer identified the ion species in the plasma pulse. The mass separated ion signals for a range of deflection voltages were analyzed to give a temporal distribution of ion species as an approximation of the ion composition in a single plasma pulse. Faraday cup measurements revealed that the alumina target produces a lower acceleration potential than an aluminum material for a laser power density of 2.0 × 10^8 W/cm^2 but the disparity became less apparent as the laser energy was increased. Mass separated ion signals show the presence of mainly Al, O and C with charge states of up to +3 for both the aluminum and alumina laser targets. Large amounts of singly charged oxygen and aluminum ions were detected for the alumina target taking up half of the ion population whereas the higher charge state ions and other ion species were kept below 10%. However, for the aluminum target, singly charged aluminum ions dominate the ion population in the plasma pulse for all laser power densities with other ions and higher charge state aluminum ions stay below 30%. The ratio of the produced oxygen ions in the plasma pulse for the alumina target attest to the possibility of alumina as a solid source of oxygen.

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