Two-photon laser-induced fluorescence of hydrogen atom in EUV photoionized plasma

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Extreme-ultraviolet (EUV) light sources are being investigated intensively as a promoting application for lithography. Laser-produced Tin (Sn) plasma is one of the most significant EUV sources with a peak emission at 13.5 nm. Molybdenum silicon layered hetero structures (Mo/Si multilayers) are usually used as artificial Bragg crystals to collect the EUV light. However, the laser-produced Sn ions deposits on the highly delicate collector, and the reflectivity will be reduced. Hydrogen flow is applied to buffer the Sn ions and reduce the deposition rate on collector in the EUV lithography. Simultaneously, the hydrogen gas can be photoionized by the EUV radiation. Hydrogen radical (H^*) is one of the most important production due to EUV dissociative photoionization. H^* can be used to clean the EUV highly delicate optics based on the reaction of $Sn + 4H^* \rightarrow SnH_4$. Detailed H^* information under various conditions is needed in order to understand and predict their long-term impact on EUV optics. Laser-induced-fluorescence (LIF) is used to evaluate the spatial distribution and temporal evolution of the hydrogen radical's density on ground state. In the experiment, H^* is excited from $1s^2S$ to the $3s^2S$ and $3d^2D$ levels with two photons near 205.14 nm at a laser intensity of 4.45×10^6 W/cm^2. Then, the fluorescence at Balmer-α near 656.28 nm can be observed with the photomultiplier tube. The temporal evolution of H^* density on ground state is determined from the fluorescence intensity.