Abstract Submitted
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Laser-induced metal plasmas for pulsed laser deposition of metal-oxide thin films[1] ERIK WAGENAARS, York Plasma Institute, University of York, UK, JAMES COLGAN, Los Alamos National Laboratory, USA, SUDHA RAJENDIRAN, ANDREW ROSSALL, York Plasma Institute, University of York, UK — Metal and metal-oxide thin films, e.g. ZnO, MgO, Al_2O_3 and TiO_2, are widely used in e.g. microelectronics, catalysts, photonics and displays. Pulsed Laser Deposition (PLD) is a plasma-based thin-film deposition technique that is highly versatile and fast, however it suffers from limitations in control of film quality due to a lack of fundamental understanding of the underlying physical processes. We present experimental and modelling studies of the initial phases of PLD: laser ablation and plume expansion. A 2D hydrodynamic code, POLLUX, is used to model the laser-solid interaction of a Zn ablation with a Nd:YAG laser. In this early phase of PLD, the plasma plume has temperatures of about 10 eV, is highly ionized, and travels with a velocity of about 10-100 km/sec away from the target. Subsequently, the plasma enters the plume expansion phase in which the plasma cools down and collision chemistry changes the composition of the plume. Time-integrated optical emission spectroscopy shows that Zn I and Zn II emission lines dominate the visible range of the light emission. Comparison with the Los Alamos plasma kinetics code ATOMIC shows an average temperature around 1 eV, indicating a significant drop in plasma temperature during the expansion phase.

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