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Early Formation of Uranium Monoxide in Laser-Ablated Plasmas: Constraints on the Rate Coefficients from Ultrafast Spectrometry and Plasma-Chemistry Models[1] DAVIDE CURRELI, MIKHAIL FINKO, University of Illinois at Urbana Champaign, Urbana, IL 61801, MAGDI AZER, Illinois Applied Research Institute, Champaign, IL 61820, MIKE ARMSTRONG, JONATHAN CROWHURST, HARRY RADOUSKY, TIMOTHY ROSE, ELISSAIOS STAVROU, DAVID WEISZ, JOE ZAUG, Lawrence Livermore National Laboratory, Livermore, CA 94550 — The mechanisms regulating uranium chemical fractionation in post-detonation nuclear debris are not well understood. The fractionation process alters the chemistry of the nuclear debris so that it no longer reflects the chemistry of the source weapon. We have measured time-resolved vibronic emission spectra of uranium monoxide (UO) formed after laser ablation of the metal in gaseous oxygen. Tests with different oxygen isotopes of $^{238}U^{16}O$ and $^{238}U^{18}O$ have allowed to uniquely identify a convenient molecular emission line that can be tracked over time to characterize the kinetics of UO formation in the cooling plasma plume. Comparison with a Monte-Carlo Plasma Chemistry model including a detailed thermochemistry of uranium combustion has allowed for the first time to constrain the rate coefficients and highlight the dominant reaction pathways of UO formation in oxygen atmospheres.

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