Contribution ID: **603** Type: **Oral**

High-temperature uranium plasma chemistry

Friday 28 June 2019 10:30 (30 minutes)

U plasma spectroscopic features are very dense with the presence of large number of atomic and ionic transitions. For example, U spectrum contains ˜100000 lines in the UV and visible spectral range originating from ˜1600 energy levels. The spectral features become more complex in the presence of oxygen containing ambient atmosphere which initiates plasma chemistry through oxidation/combustion of U species in the plume. We investigate the oxide emission features in a U metal plasma generated during nanosecond laser ablation of U metal target. The plasma chemistry is manipulated by controlling the ambient environment by varying oxygen partial pressures in an inert argon atmosphere. Time- and space- resolved optical emission spectroscopy, monochromatic 2D imaging employing fast-gated camera are used as diagnostic tools for exploring plasma chemistry. By comparing the expansion dynamics of uranium plumes in argon and in oxygen-rich ambient environment, we discover that chemical reactions modify the hydrodynamics of the plume at later times of its evolution when the oxygen in present in the buffer gas. A strong background-like emission is always observed in the spectral features of U plasma in oxygen-containing environment and our results highlight that it is contributed by uranium oxides. We identified several spectral bands of UO in the visible-NIR region. A study comparing the role of varying oxygen ambient concentration on plasma chemistry showed that the reaction pathways from atoms to diatoms to polyatomic molecules strongly vary with ambient oxygen concentration. Lower oxygen concentrations enhance the formation of UO from atomic uranium, whereas higher oxygen concentrations tend to depopulate both atomic uranium and uranium monoxide concentrations through formation of more complex uranium oxides. 2D monochromatic images of atomic and molecular emission features showed oxidation primarily occurs at colder region of the plume (outer regions).

Authors: Dr HARILAL, S. S. (Pacific Northwest National laboratory); Dr KAUTZ, E. (Pacific Northwest National Laboratory); Dr BERNACKI, B. E. (Pacific Northwest National Laboratory); Dr PHILLIPS, M C (University of Arizona); Mr SKRODZKI, P. (University of Michigan); Dr BURGER, M. (University of Michigan); Dr JOVANOVIC, I. (University of Michigan)

Presenter: Dr HARILAL, S. S. (Pacific Northwest National laboratory)

Session Classification: 1.6 Plasma Chemistry

Track Classification: 1.6 Plasma Chemistry