Ion-Induced Chemistry of Pt Precursors: Precursor Reactions and Spontaneous Formation of Multi-Layered PtC_x Films

Lisa McElwee-White, Johnathon M. Johnson
Department of Chemistry, University of Florida, Gainesville, FL 32611
lmwhite@chem.ufl.edu

D. Howard Fairbrother, Patrick Eckhert
Department of Chemistry, Johns Hopkins University, Baltimore, MD 21218

In ion beam induced deposition (IBID) processes, the deposition rate and deposit composition are determined by the interplay between ion-induced deposition and sputtering of the deposited atoms. To provide independent insights into these two facets of IBID, a UHV surface science approach employing *in situ* XPS and MS has been used to study how the identity of incident ions Z^+ (Z = He, Ne, Ar, H_2 or D_2) influences ion-induced deposition from adsorbed $MeCpPtMe_3$ and sputtering of the resulting PtC_x films.[1] For the heavier ions, these findings were ascribed to direct momentum/energy transfer between incident ions and adsorbed precursor molecules, while for the lighter ions there is an increasing contribution from secondary electrons generated by ion-substrate interactions. While the Pt atom purity associated with ion-induced precursor decomposition was lower for the lighter ions, ion-induced sputtering of PtC_x films by lighter ions produced the greatest increase in metal content (*i.e.*, purity), due to the extremely poor mass match with Pt. In contrast to deposition conditions in typical commercial FIB instruments, our current deposition work utilizes low energy (1-1.2 keV) Ar^+ and H_2^+ ion beams with low deposition rates on the order of 100 nm/hr. Under these conditions, we have found that films deposited from $Me_3PtCpMe$ exhibit spontaneous formation of well-ordered alternating layers of platinum and carbon with Pt and C layer thickness of ca. 8 nm.[2]

1. M. K. Abdel-Rahman, P. M. Eckhert, L. McElwee-White and D. H. Fairbrother, J. Phys. Chem. C **128** (18), 7723-7732 (2024).
2. P. M. Eckhert, J. M. Johnson, L. McElwee-White and D. H. Fairbrother, Adv. Funct. Mater., e19982 (2025).