$Pt(CO)_2Cl_2$ fragmentation upon low energy electron interactions

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Synopsis: In the present communication we present low energy electron interactions with $Pt(CO)_2Cl_2$, a FEBID precursor. Electron impact ionization as well as dissociative electron attachment studies are discussed.

Focused electron beam induced deposition (FEBID) [1-3] of metallic materials is a promising technique for controlled metal deposition on surfaces. FEBID allows precise size and thickness control of the deposit and the fabrication of three-dimensional structures on planar as well as non-planar substrates. Hence, it is a technique with promising complementary capabilities as compared to current industrial nanofabrication methods. In FEBID, precursor molecules, often organometallic compounds containing the metal to be deposited, are continuously dosed at or close to a substrate surface where they are decomposed by exposure to a high-energy electron beam. An enormous amount of low energy electrons are formed inducing further decomposition that may occur through dissociative electron attachment (DEA), dissociative ionization (DI), neutral dissociation (ND) or dipolar dissociation (DD) [4]. A novel precursor, *cis*-platinum dicarbonyl dichloride (*cis*-$Pt(CO)_2Cl_2$) has been designed specifically for use in FEBID of Pt nanostructures. This precursor was synthesized in the laboratory of Lisa McElwee-White at the University of Florida and has been tested in electron induced decomposition under ultra-high vacuum (UHV) in the laboratory of Howard Fairbrother at Johns Hopkins University (JHU) [5].

Electron impact ionisation studies have been carried out showing a rich dissociation leading to bare platinum cation. Appearance energies (AE) for all detected cations are presented in Table 1.

Table 1. Appearance energies

Cation	AE	Error (%)
$Pt(CO)_2Cl_2$	11.07	9
$PtCOCl_2$	11.25	11
$Pt(CO)_2Cl$	12.11	3
$PtCl_2$	14.22	2
PtCl	17.81	2
PtCOCl	15.48	5
PtCO	17.18	2
PtC	26.66	2
Pt	19.91	3

Dissociative electron attachment leads predominantly to the loss of a carbonyl (CO) group at ~0 eV electron impact energy (Figure 1). Loss of two CO ligands is due as well to the excess of energy via a resonant process at 3.5 eV.

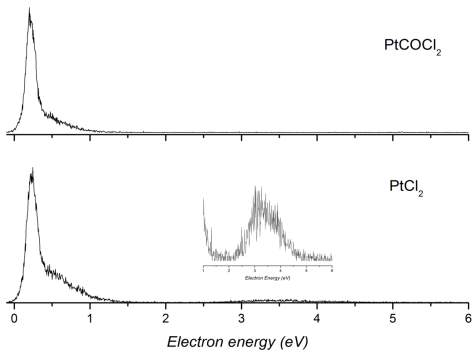

Figure 1. Ion yield for $PtCOCl_2$ and $PtCl_2$ for electron attachment of $Pt(CO)_2Cl_2$ as a function of electron energy.

References

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