

## Electron scattering in $\text{Pt}(\text{PF}_3)_4$ : Elastic scattering, vibrational and electronic excitation

This content has been downloaded from IOPscience. Please scroll down to see the full text.

2012 J. Phys.: Conf. Ser. 388 052060

(<http://iopscience.iop.org/1742-6596/388/5/052060>)

View [the table of contents for this issue](#), or go to the [journal homepage](#) for more

Download details:

IP Address: 134.21.16.139

This content was downloaded on 22/10/2014 at 13:56

Please note that [terms and conditions apply](#).

## Electron scattering in Pt(PF<sub>3</sub>)<sub>4</sub>: Elastic scattering, vibrational and electronic excitation

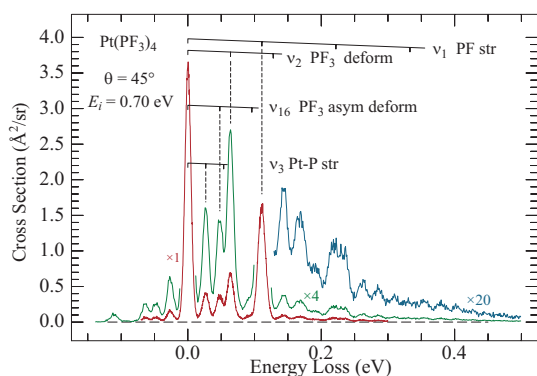
Michael Allan<sup>1</sup>,

Département de Chimie, Université de Fribourg, 1700 Fribourg, Suisse

**Synopsis** Absolute cross sections for elastic scattering, and vibrational and electronic excitation by electron impact are presented for Pt(PF<sub>3</sub>)<sub>4</sub>.

The interest in electron interactions with Pt(PF<sub>3</sub>)<sub>4</sub> is motivated by its use as a platinum precursor for the deposition of nano-sized wires in the method of Focused Electron Beam Induced Processing (FEBIP) [1]. It has the advantage, over precursors with carbon-containing ligands, of not causing carbon deposits. It is a very remarkable compound, volatile enough to be measured at room temperature, despite its high molar mass (547 amu!). Remarkable is already its vibrational energy-loss spectrum, shown in Fig. 1. The Pt–P stretch vibration has a frequency of only 27 meV and can be used to monitor the purity of the sample. The P–Pt–P deformation vibration has a frequency of only 6 meV and can not be resolved.

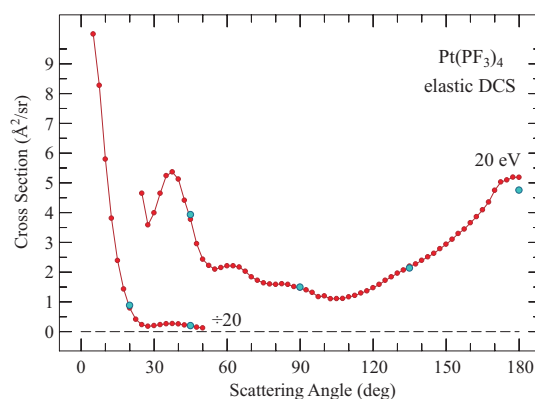
Experimental absolute differential cross sections for elastic scattering, and vibrational and electronic excitation by low-energy electrons were measured. Electronically excited states were characterized by electron energy-loss spectroscopy.



**Figure 1.** Electron energy-loss spectrum.

The elastic cross section has a deep Ramsauer-Townsend minimum around 0.25 eV (at  $\theta = 135^\circ$ ). The angular distributions of the elastic cross section above 6.5 eV show an unusually narrow peak at an angle which decreases with increasing energy, and wavy structure at

higher angles. The peak is at  $40^\circ$  in the 20 eV cross section, shown in Fig. 2. It is proposed that these features are related to the high (tetrahedral) symmetry of Pt(PF<sub>3</sub>)<sub>4</sub>, which has the consequence that the angular distribution depends only weakly on the orientation of the target, so that it is nearly not smeared out by random target orientations.



**Figure 2.** Elastic cross section at 10 eV.

Vibrational excitation cross sections revealed 5 shape resonances, at 0.84, 1.75, 3.3, 6.6 and 8.5 eV. With reference to Density Functional Theory (DFT) virtual orbital calculations with effective potential for the inner electrons, the lowest two resonances were assigned to temporary occupation of the P–F  $\sigma^*$  orbitals, ‘pushed up’ by interaction with the occupied  $d$ -orbitals of Pt.

The electronic energy-loss spectra revealed excited states at 5.8, 6.8, 7.4, 8.4 and 11 eV which were all assigned as Rydberg states. The electronic cross sections reach very large values in the forward direction.

### References

- [1] I. Utke, P. Hoffmann, and J. Melngailis 2008 *J. Vac. Sci. Technol.* **467** 1197.

<sup>1</sup>E-mail: Michael.Allan@unifr.ch