



# Office of Technology Management

## *Preparation of Highly Dispersed Noble Metals on Carbon Substrates for PEM Fuel Cell MEAs or Catalysts*

### Technology Reference

CV59

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### Field

Catalysis

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### License Status

Seeking licensing partners

### Patent Status

Utility patent filed

### Overview

In many applications such as heterogeneous catalysts and fuel cell electrodes, small particles of Pt are mounted, by numerous techniques, onto high surface area carbon supports. Due to its expense, it is usually desired to have Pt in the form of very small particles, which maximizes the amount of exposed Pt surface and hence the catalytic activity. This condition is known as high "dispersion." In addition, many fuel cell applications require the use of high weight loadings of Pt at high dispersion. We have discovered a way to prepare highly dispersed, highly loaded Pt on a wide range of carbon, including conductive carbon black of the sort used in fuel cell electrodes that is considerably simpler and more effective than methods reported in the open and patent literature. This technology is useful even for medium and low noble metal loadings as the high dispersions achieved will maximize the catalytic activity of the metals used.

The current method of choice to prepare fuel cell electrodes includes up to eight separate and cumbersome steps (see Masahiro Watanabe) involving Pt sulfite complexes and PtO<sub>2</sub> sols. In contrast, our method contains only one step in place of the eight, and utilizes the most common source for dissolved platinum, chloroplatinic acid (CPA). CPA impregnation of carbon black has been attempted in the past but failed due to a lack of control of a key variable. Our work has identified and utilizes this key parameter.

### Technical Summary

We've discovered a simple way to adsorb a large amount (up to about 9 wt %) of Pt onto Vulcan XC-72, the carbon black of industrial choice for fuel cell electrodes. We have learned how to adjust the process parameters to account for key characteristics of the carbon substrate. In one simple adsorption step we can achieve a high loading of Pt complexes that are, to that point, perfectly dispersed. Initial results indicate that the high dispersion of the just-adsorbed coordination complexes (which are of approximate composition [PtCl<sub>3</sub>(OH)<sub>3</sub>]-2) can be retained as the metal is reduced to Pt<sup>0</sup>. Of course, this process can also be applied to low to medium metal loadings.

### Benefits

- Higher loadings of noble metals at high fine dispersions
- PEM fuel cells are gaining a lot of interest. This could make them better and smaller.
- If the dispersion makes the catalyst more active, which it should, it could result in a more economic fuel cell.

### Areas of Application

- PEM fuel cell electrodes and noble metal catalysts on carbon supports (hydrogenation and dehydrogenation)

### Stage of Development

- Proof of concept at laboratory scale
- PEM Fuel cell electrode materials (I.e., catalysts) have been produced for testing

