Ordered Intermetallics as Electrocatalysts for Fuel Cell Applications

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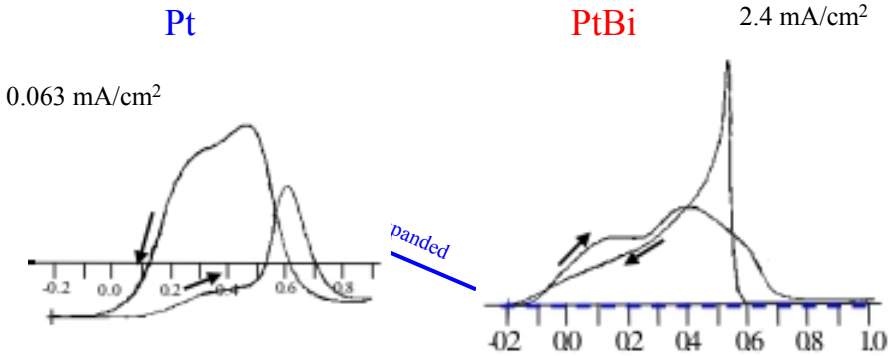
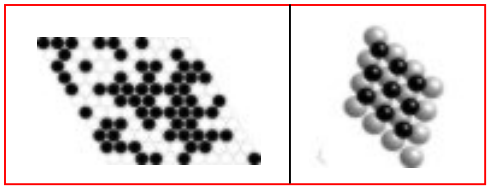
Pt

(111) plane Pt-Pt 2.77 Å



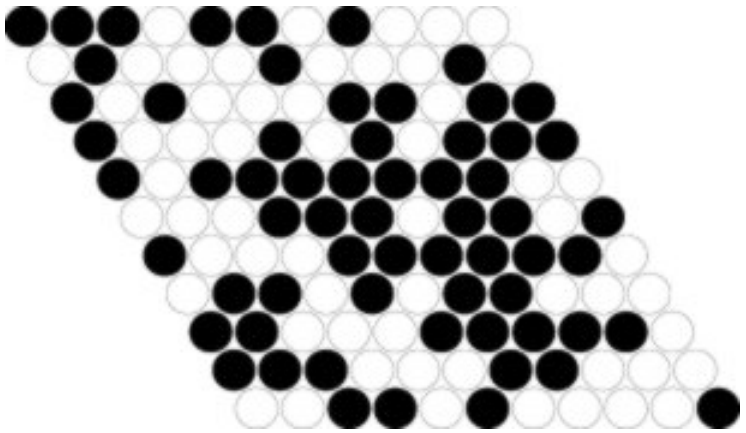


PtBi

(001) plane Pt-Pt 4.32 Å

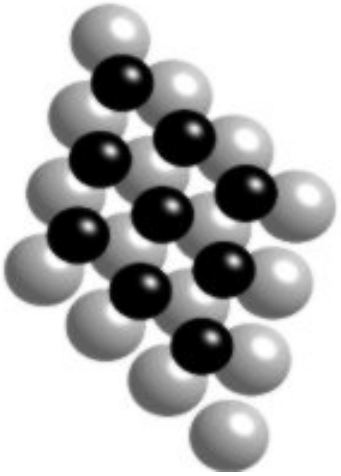
Alloys vs. Ordered Intermetallics

Alloy; e.g. Pt/Ru (1:1)



(A)

Ordered Intermetallic
e.g. BiPt



(B)

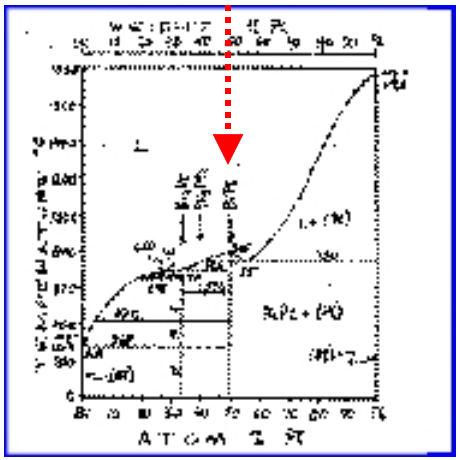
Bismuth Platinum (BiPt) Intermetallic Phase

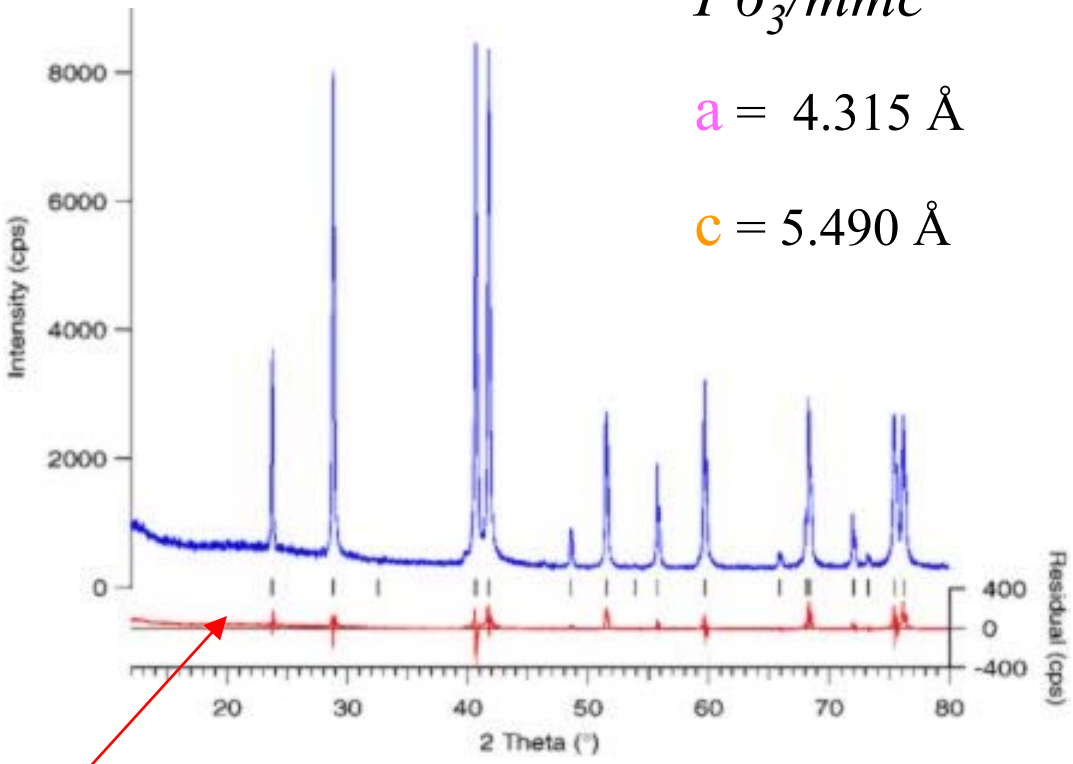
- Powder X-ray Diffraction Refinement for BiPt

$P6_3/mmc$

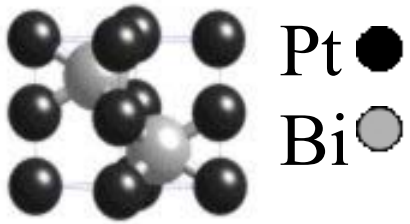
a = 4.315 Å

c = 5.490 Å

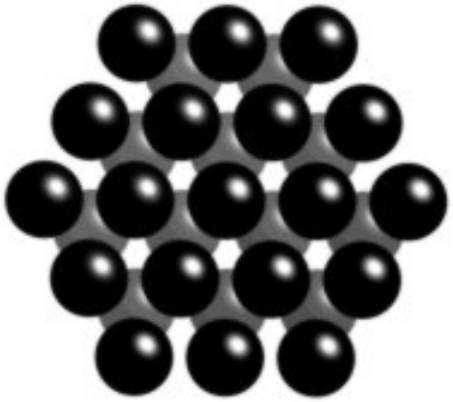




---- Residual between experimental and theoretical results



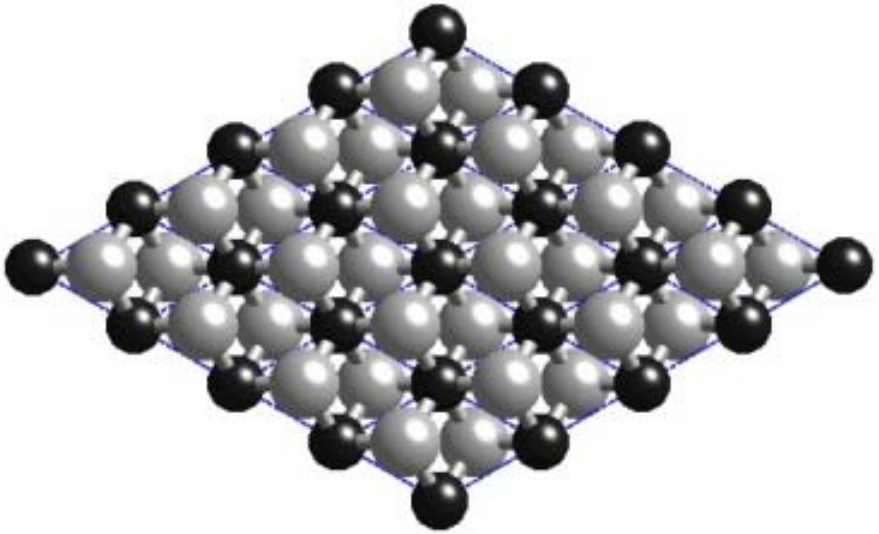
Platinum vs. PtBi



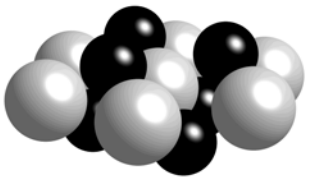
Pt

(111) plane

Pt-Pt 2.77 Å



PtBi



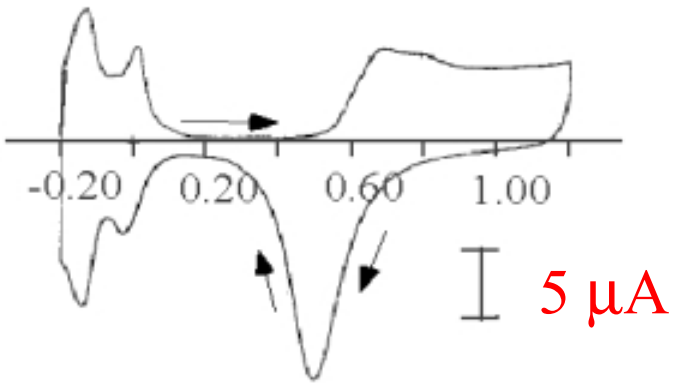
(001) plane

Pt-Pt 4.32 Å

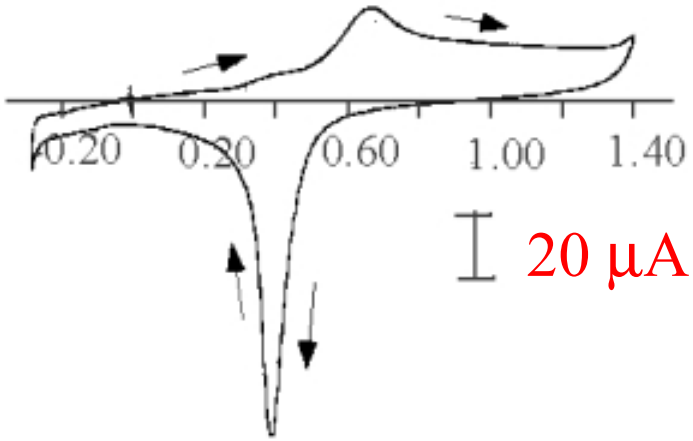
Voltammetric Profile in H_2SO_4

- Cyclic Voltammetry in 0.1 M H_2SO_4 at a sweep rate of 10 mV/s

Pt



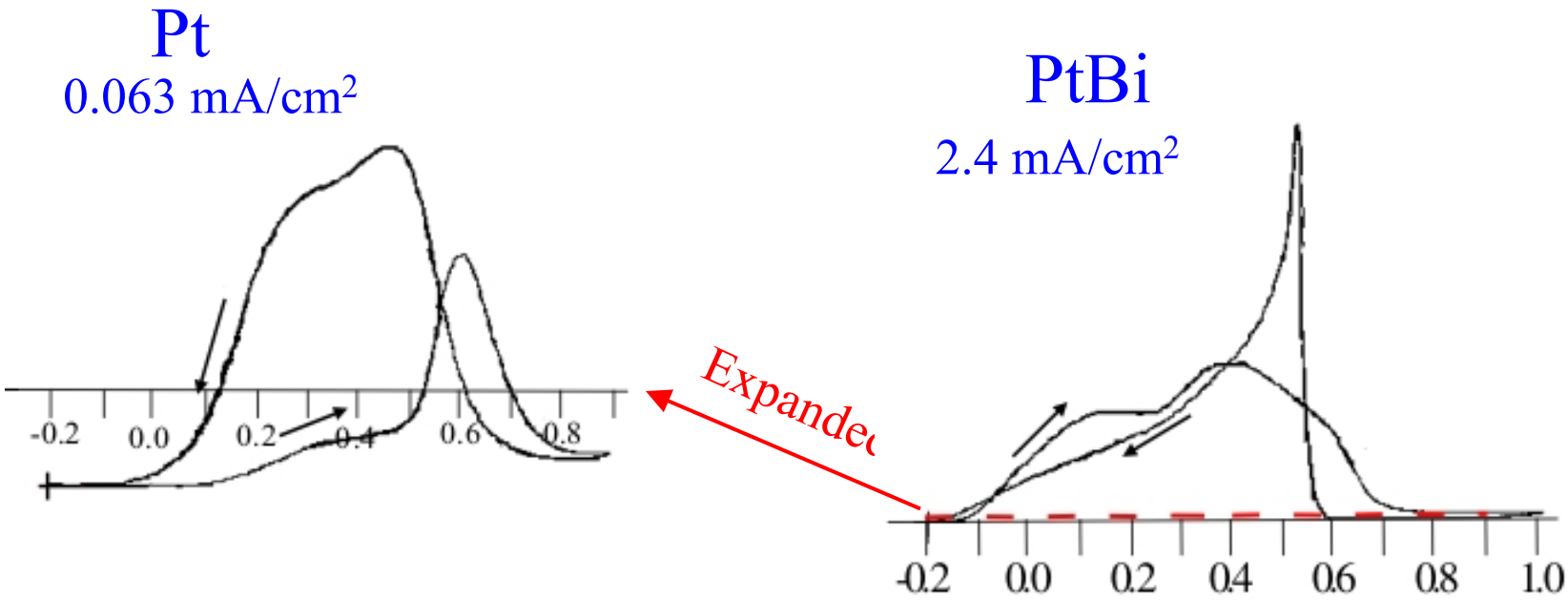
PtBi



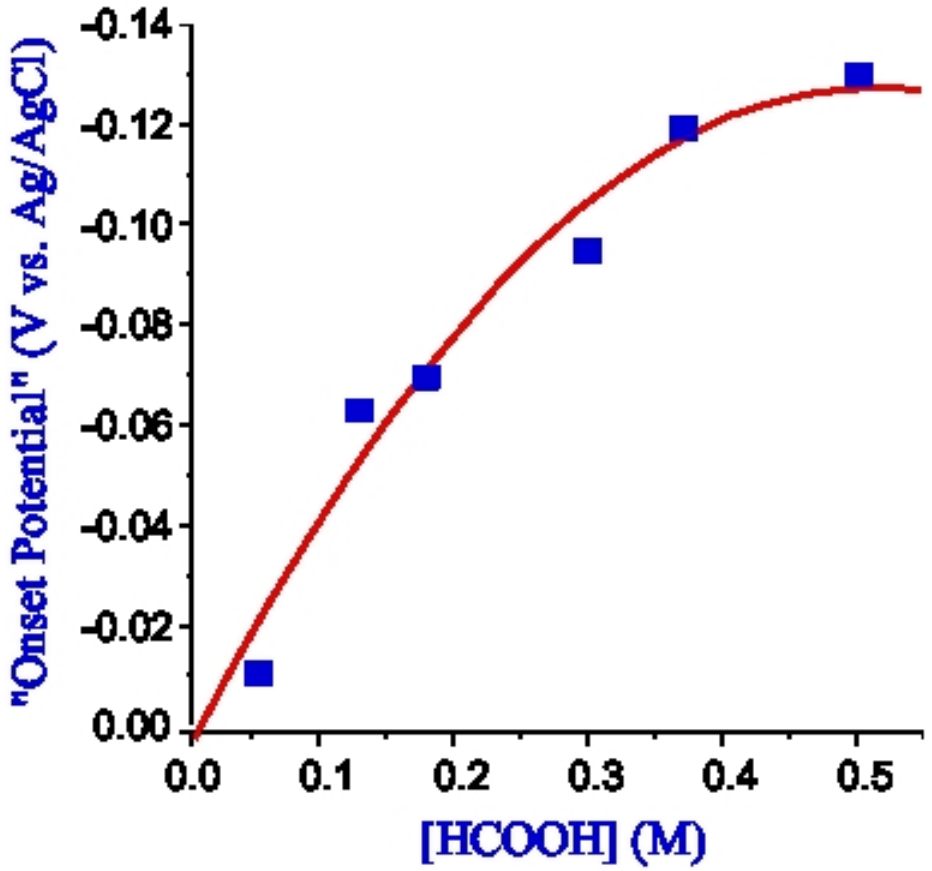
E(V) vs. Ag/AgCl

Enhanced Catalytic Activity for Formic Acid Oxidation

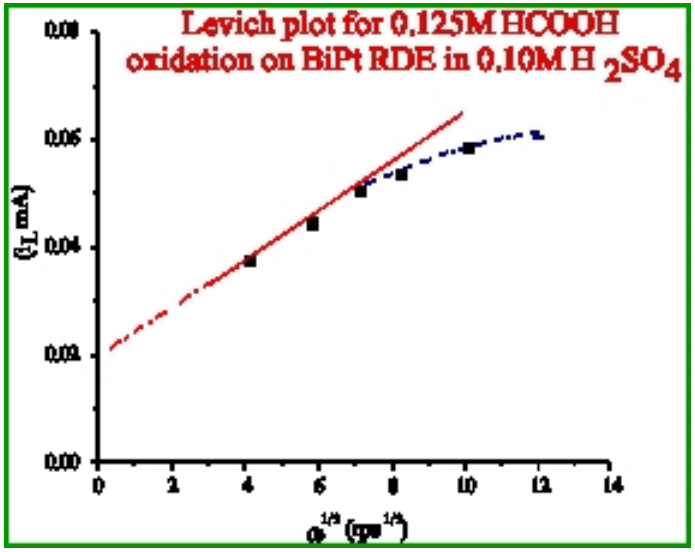
- Cyclic Voltammetry in 0.1 M H_2SO_4 + 0.125 M formic acid solution at a sweep rate of 10 mV/s

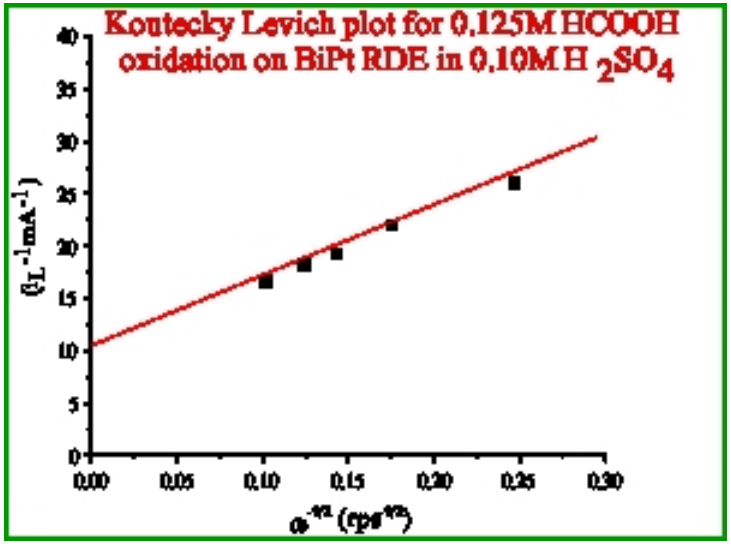


Onset Potential (obtained at 10 mA/cm^2)
as a function of the Formic Acid concentration.

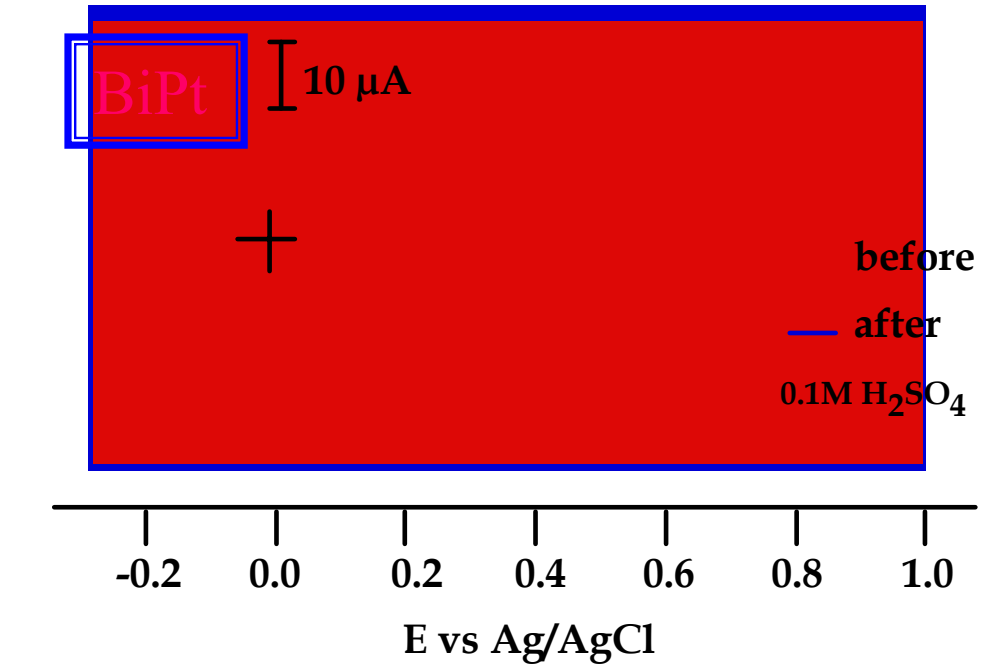


Rotating Disk Electrode Characterization

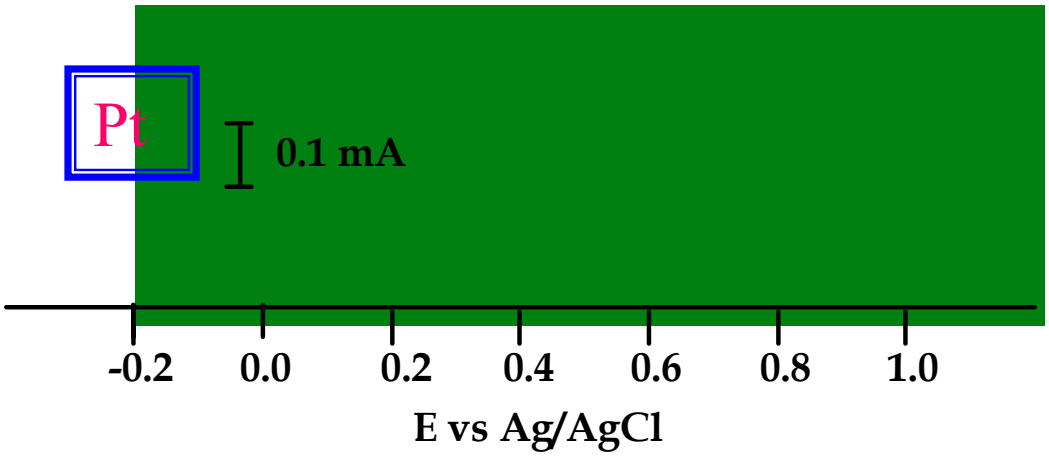




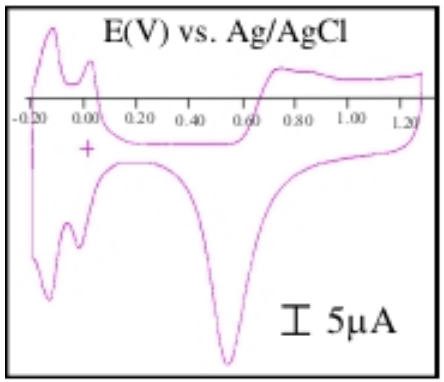
CO Tolerance



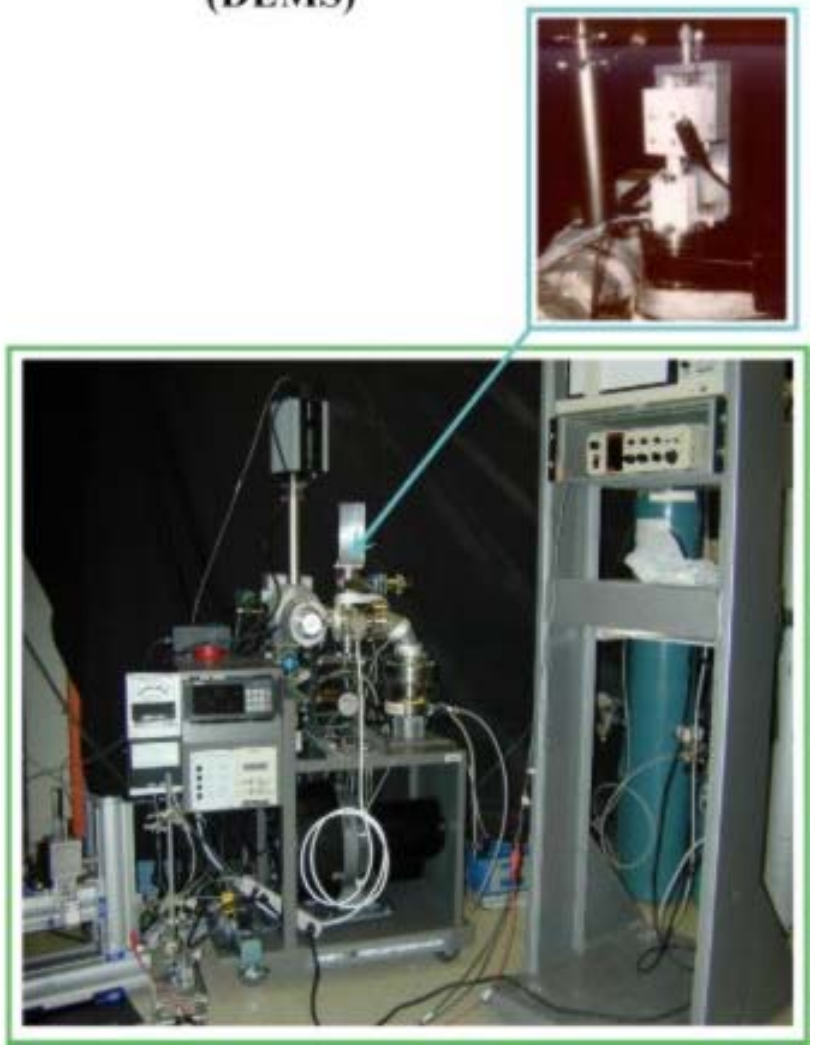
Cyclic voltammograms at 50 mV/sec for a BiPt electrode in 0.1M H_2SO_4 before and after exposure to CO



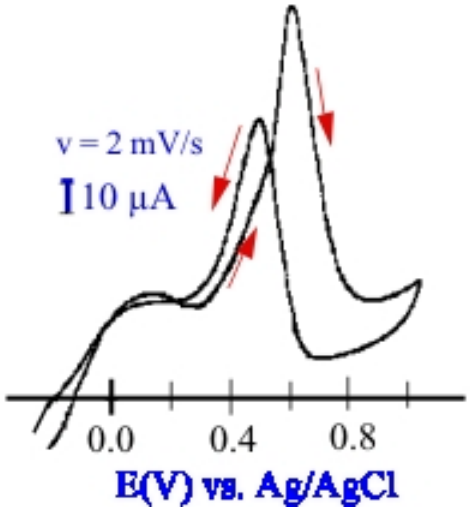
CO Adsorption on a polycrystalline Pt surface

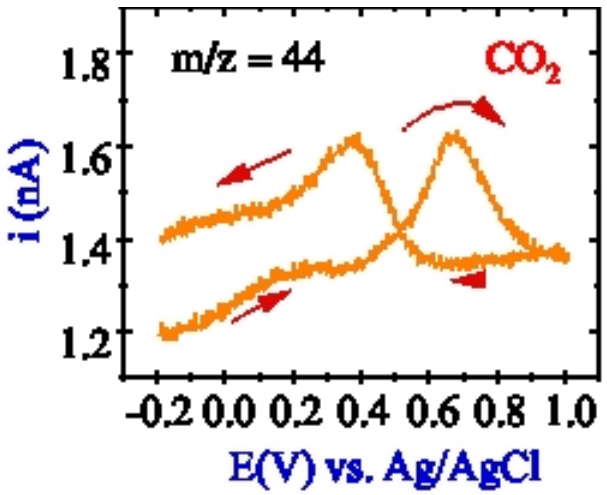


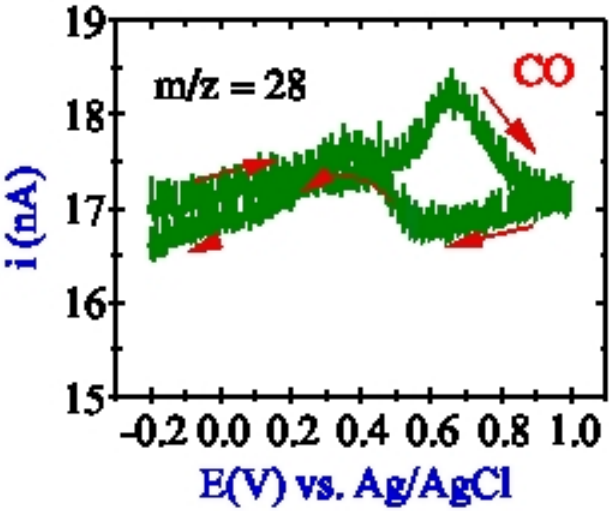
Differential Electrochemical Mass Spectrometry
(DEMS)

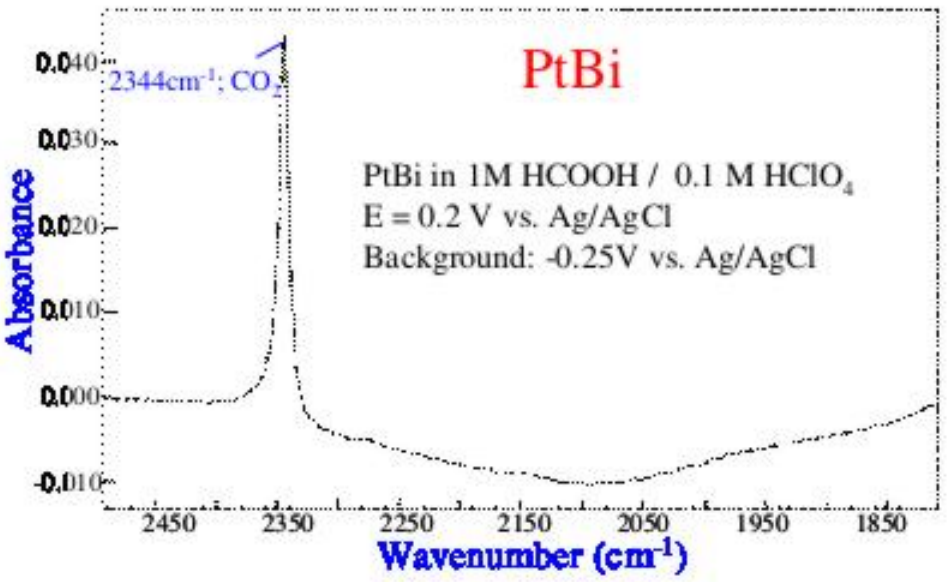


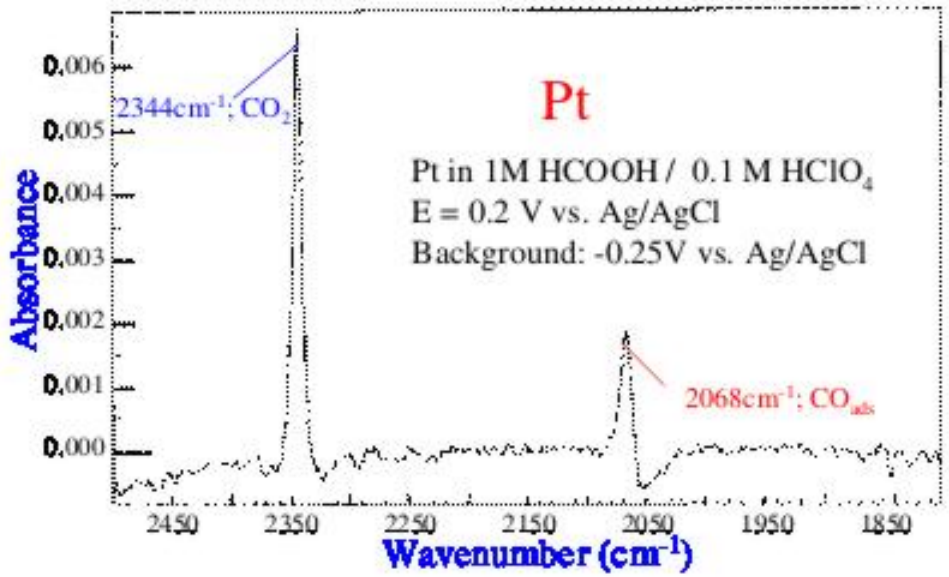
DEMS for BiPt in 0.125 M HCOOH, 0.1 M H_2SO_4











FT-IR Studies of CO_2 and CO formation at BiPt and Pt electrodes during formic acid oxidation.

Conclusions:

We have studied the electrocatalytic activity of the ordered intermetallic BiPt toward formic acid oxidation. This material exhibits enhanced electrocatalytic activity when compared to polycrystalline platinum. Using cyclic voltammetry, rotating disk electrode voltammetry (RDE), FTIR and DEMS (differential electrochemical mass spectrometry) we have characterized the current density, onset potentials, kinetics of oxidation, reaction intermediates, and product distribution.

Coworkers:

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$upport:

NSF, DOE