Synthesis of Pt and PtRu Nanoparticles for Anode Catalysts of Direct Methanol Fuel Cells (DMFCs)

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Motivation

- Pt and Pt-alloy nanoparticles can be used as anode catalysts for Direct Methanol Fuel Cells (DMFCs).
- Polyalcohol reducing synthetic approaches allow good control over the particle size and shape.
- To activate the nanoparticles, organic capping agents binding on particle surfaces need to be completely removed.
- Electrocatalytic activity of particles can be characterized by Cyclic Voltammetry (CV).

Synthetic procedures for Pt nanoparticles

\begin{verbatim}
Pt(acac)_2 (95 mg) + Hexadecanediol (390 mg) + Diphenyl ether (20 ml)  
↓ Heat to 110 °C (N\textsubscript{2} atmosphere)  
↓ Inject oleylamine (1.36 ml)  
↓ Heat to 175 °C  
↓ Keep T=175 °C for 45 min  
↓ Stop heating and cool down to 50 °C  
↓ Wash with ethanol and disperse in Hexane  
↓ Isolate Particles by Centrifugation
\end{verbatim}

Synthetic procedures for PtRu nanoparticles

\begin{verbatim}
Pt(acac)_2 (80 mg) + RuCl\textsubscript{3} (44 mg) + Diphenyl ether (20 ml)  
↓ Heat to 110 °C (N\textsubscript{2} atmosphere)  
↓ Inject oleylamine (1.36 ml)  
↓ Inject 4 ml 1.0 M super hydride  
↓ Reflux for 1 hr  
↓ Stop heating and cool down to 30 °C  
↓ Wash with ethanol and disperse in Hexane  
↓ Isolate Particles by Centrifugation
\end{verbatim}

Summary

- Pt and PtRu nanoparticles with narrow size distributions were synthesized by chemical reducing approaches.
- As-prepared Pt nanoparticles can be activated through annealing the particles in air at 185°C.
- PtRu nanoparticles can be transferred from organic solvents to water solution and are stabilized by electrostatic interaction.
- The activated Pt and PtRu nanoparticles show good catalytic activity for methanol oxidation.

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