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Anisotropic Growth of Platinum Nano-Multipods

Nanometer-sized branched nanocrystals (multipods) of metal, metal oxide and semiconducting materials have intrinsic electronic, magnetic, photonic and catalytic properties that make them suitable as building blocks for complex nanostructures. Such multipods, such as 3D tetrapod nanocrystals, may find use in the generation of hierarchical nanostructured networks. Tetrapods of CdSe and CdS have already been developed, and multipods and hyperbranched nanostructures are being investigated. However, the anisotropic growth needed to produce branched nanocrystals for other metals has not been achieved, perhaps because the metals are not polymorphic. Only platinum (Pt), rhodium and gold are known to form branched nanocrystals.

Now, scientists at the University of Rochester, New York, U.S.A., report an induced anisotropic growth process for making Pt multipods from Pt acetylacetonate ($(Pt(acac)_2$) at temperatures below that at which Pt nanoparticles are nucleated and grown (X. Teng and H. Yang, *Nano Lett.*, 2005, **5**, (5), 885–891).

To induce nucleation and branched Pt nanocrystal growth, 3 mg of silver acetylacetonate was added to 200 mg of $Pt(acac)_2$ in diphenyl ether with complexing agents, at temperatures from 160 to 210°C, and reaction times of 4.5 to 60 min. Three distinct temperature-dependent regimes, were observed:

- Without the Ag, no Pt particles formed for the entire reaction period of 60 min, at temperatures 160 to 175°C.
- Multipods were formed at 2.5 to 4.5 min after the Ag addition for reactions at 180 to 200°C.
- The multipods turned into spheres after reaction for a further 10 to 15 min (at 180 to 200°C).

Injecting more $Pt(acac)_2$ into the reaction mixture of three equal aliquots at 7, 9 and 12 min after Ag addition extended the multipod growth process. The transition time from multipods to spherical particles increased to 30 min and some multipods could still be seen at 60 min.

The morphologies of Pt multipods made include I- and V-shaped bipods, various types of tripods, and planar and 3D tetrapods. It is concluded that using this method, multipods of different metals could be produced, and be nanoscale building blocks for complex functional nanostructures through self-assembly.

Rhodium Catalysts Bound to Polyelectrolytes

Homogeneous catalysts based on soluble transition metal complexes exhibit high activities and selectivities under mild reaction conditions, but are not easily recovered from the reaction products. Now, researchers from the Universität Konstanz, Germany, report recoverable rhodium (Rh) homogeneous catalysts electrostatically bound to hyperbranched polymers (E. Schwab and S. Mecking, *Organometallics*, 2005, **24**, (15), 3758–3763).

Polyelectrolytes with $Ph_2P(C_6H_4$-*p*-$SO_3^-)$ counterions were prepared by ion exchange from hyperbranched polycations with a polyglycerol-based polyether scaffold and 1,2-dimethylimidazolium end groups. After the polyelectrolytes and $[Rh(acac)(CO)_2]$, in DMSO-d_6, were exposed to 1 atm CO/H_2, most of the Rh precursor converted to $[(phosphine)_3Rh(H)(CO)]$. Hydroformylation of 1-hexene in methanol proceeded with moderate activity at 80°C and 30 bar CO/H_2. The Rh-polyelectrolyte catalyst could be recovered by ultrafiltration and reused.

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Chemical Extraction of Precious Metals

SOLVENT EXTRACTION CHEMISTRY OF PRECIOUS METALS

EDITED BY JIANMIN YU, (in Chinese), Chemical Industry Press, Beijing, China, 2005, 340 pages
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This book, combining theory and practice, provides detailed data obtained during studies on the chemistry of solvent extraction of the precious metals in China and abroad. The book has 14 chapters, organised by the main theme of the solvent extraction chemistry of the platinum group metals, gold and silver.

The sources, properties, uses and separation methods of precious metals are introduced in Chapter 1. Aqueous solution chemistry and the fundamental theory of solvent extraction chemistry, with various extractants for the precious metals, are reviewed in Chapters 2 to 4. Chapters 5 to 10 cover methods of separation using solvent extraction and related technologies, for gold, palladium, platinum, rhodium, iridium, osmium, ruthenium and silver, and comprise the most important part of the book..

The last four chapters discuss integrated solvent extraction separation technologies, extraction synergistics and kinetic. There are 4 Appendices which describe the main extractants, dilutants and data on their parameters for solvent extraction and separation. Product standards in China, U.S.A., and Russia are given. The book is illustrated by colour photographs of pilot and industrial plants in China.

The Editor of the Book

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