

Method of Preparation of Atomic Metal Composites (#5217)

Method for assembling atoms one-by-one into highly efficient multiatomic catalytic clusters

One solution to improve catalytic efficiency while reducing precious metal usage is to build metal clusters from a “bottom-up” approach by assembling individual atoms one by one into multiatomic clusters. A stable organic semiconductor, polyaniline, as the isolation matrix is used to produce the atomic clusters, which can consist of few atoms of the same metal or atoms of different metals. Customizable atomic composition produces certain distinct chemical properties, which have followed theoretically predicted catalytic properties. Production of these catalysts requires significantly less precious metal (by a factor of one to ten thousand) while maintaining comparable catalytic efficiency. This has been demonstrated by electrooxidations of propanol as well as other aliphatic alcohols by not only atomic gold consisting of 2-7 metal atoms but also atomic alloys of palladium and gold in different atomic ratios.

Benefits/Advantages

- **Efficient** — Atomic level catalyst dispersion to maximize available catalytic sites
- **Controllable** — Atomic control of cluster formation to generate pure metal and alloy catalysts of specific size and is scalable
- **Economical** — Minimal precious catalytic metal needed

Potential Commercial Applications

- Fuel cells (vehicle market, stationary and portable power, off-road applications, marine vessels, consumer electronics, direct fuel cells, etc.)
- Gas sensors (lower explosive limit, carbon monoxide, breathalyzer, oxygen, etc.).

Background/Context for This Invention

Properties, preparation, and practical applications of metal catalysts depend on their size. When it is on the order of tens of nanometers and larger, the clusters contain millions and millions of atoms. Such clusters consist of active surface atoms while the rest have properties characteristic of organized but inactive bulk phase. Their preparation is typically done in the “top-down” manner, essentially starting from a large object and using the size as the controlling parameter during the various scaling-down processes. The resulting devices contain substantial percentage of non-active metal catalyst.

Dr. Jiri Janata

Professor Emeritus — Georgia Tech Department of Chemistry and Biochemistry

More Information

Publications

For more information about this technology, please visit:

<https://licensing.research.gatech.edu/technology/method-preparation-atomic-metal-composites>

Images:

The automated sequential delivery of multiple fluids. A varying number of delay gates imprinted in the

branches are shown in the figure.

COVID-19 and flu saliva test on paper: (A) The automatic sequential delivery of multiple reagents required for virus test; (B) Water pouring into the device triggers the virus assay, allowing the presence of SARS-CoV-2 and influenza A & B viruses to be visually identified by the color changes in the corresponding detection spot