Sibakoti, T. R., Jasinski, J. B., Nantz, M. H., & Zamborini, F. P. (2020). Iodine activation: A general method for catalytic enhancement of thiolate monolayer-protected metal clusters. *Nanoscale*, *12*(22), 12027-12037. https://doi.org/10.1039/D0NR00844C

Definitions

- **Iodine Activation**: A process where iodine is used to remove some protective ligands from metal clusters, making them more reactive.
- **Thiolate Ligands**: Organic molecules attached to metal clusters to stabilize them.
- **Monolayer-Protected Clusters (MPCs)**: Metal nanoparticles covered with a single layer of organic molecules for stability.
- **Catalytic Activity**: The ability of a substance to increase the rate of a chemical reaction.

Key Findings

- Adding iodine enhances the catalytic activity of metal clusters by partially removing thiolate ligands.
- This process exposes more of the metal surface, making the clusters better catalysts.
- Iodine-treated clusters showed increased reaction rates for both the reduction of 4-nitrophenol and the hydrogenation/isomerization of allyl alcohol.

Introduction

This study explores a method to improve the catalytic performance of metal clusters protected by thiolate ligands. By adding iodine, some of these ligands are removed, exposing more of the metal surface and enhancing the clusters' reactivity.

Main Content

Background

Metal clusters coated with thiolate ligands are used in various chemical reactions as catalysts. These ligands stabilize the clusters but also limit their reactivity by covering the metal surface. The study investigates using iodine to partially remove these ligands, thereby increasing the clusters' catalytic activity.

Methods

- **Preparation of Metal Clusters**: Gold (Au) and palladium (Pd) clusters were synthesized and coated with glutathione ligands.
- **Iodine Treatment**: Different amounts of iodine were added to the clusters to remove some of the ligands.

- **Catalytic Tests**:
    - *4-Nitrophenol Reduction*: The clusters were tested for their ability to speed up the reduction of 4-nitrophenol to 4-aminophenol.
    - *Allyl Alcohol Reaction*: The clusters were tested for their effectiveness in converting allyl alcohol to 1-propanol and propanal.

Results

- **4-Nitrophenol Reduction**:
    - Without iodine: Slow reaction.
    - With iodine: Reaction rate increased significantly with higher iodine amounts.
- **Allyl Alcohol Reaction**:
    - Without iodine: Slow conversion.
    - With iodine: Faster conversion rates, showing enhanced catalytic activity.

Conclusion

The study demonstrates that iodine activation is an effective method to enhance the catalytic activity of thiolate-protected metal clusters. By removing some ligands, more of the metal surface is exposed, leading to better performance in catalysis. This method could be applied to various catalytic processes, offering a simple and effective way to improve catalyst efficiency.

Word Count: 363