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SEMINARIO

"Uncovering structure-property relationships: from studies of pure and supported metal clusters and colloids to their use in catalysis and sensing".

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Uncovering structure-property relationships: from studies of pure and supported metal clusters and colloids to their use in catalysis and sensing.

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Insight into the nature of pure and support-immobilized atomically precise metal clusters and well-defined colloids is of fundamental importance since such metal nanoparticle precursors are useful for the development of better catalysts and sensors.

Our detailed DFT studies of the ligated clusters allowed systematic identification of bands observed in the far-IR spectra (obtained at the Australian Synchrotron)[1-3] as well as better understanding of their de-ligation[4] and interpretation of the ultra-high resolution electron microscopy images of clusters supported on titania nanosheets.[5]

Results of recent synchrotron XPS/XAS studies of pure and supported clusters and colloids reveal their unique electronic properties and highlight the importance of support chemistry, which could be tuned by pre-treatments, in controlling aggregation of clusters.[6-8]

Our catalytic studies highlight the effects of support and gold particle size in electrocatalytic oxidation of glycerol,[9-12] initiator- and solvent-free aerobic oxidation of cyclohexene[13,14] and effects of the nature of the cluster/colloid precursors and activation treatments in the aerobic oxidation of benzyl alcohol.[15] We have also demonstrated that green catalytic process of aerobic oxidation of amines to nitriles can be driven by the visible light using hydrous ruthenium oxide nanoparticles on TiO_2.[16]

The Au-WO_3-based composites fabricated using clusters (Au_9) and colloids (Au_{101}) demonstrate excellent performance as optical and conductometric sensors for hydrogen, providing evidence that ultra-small clusters outperform large NPs.[17,18] We have also demonstrated sensing (including size effect) of important toxins and viruses at nanomolar concentrations by the surface-modified Au colloids.[19,20]

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