

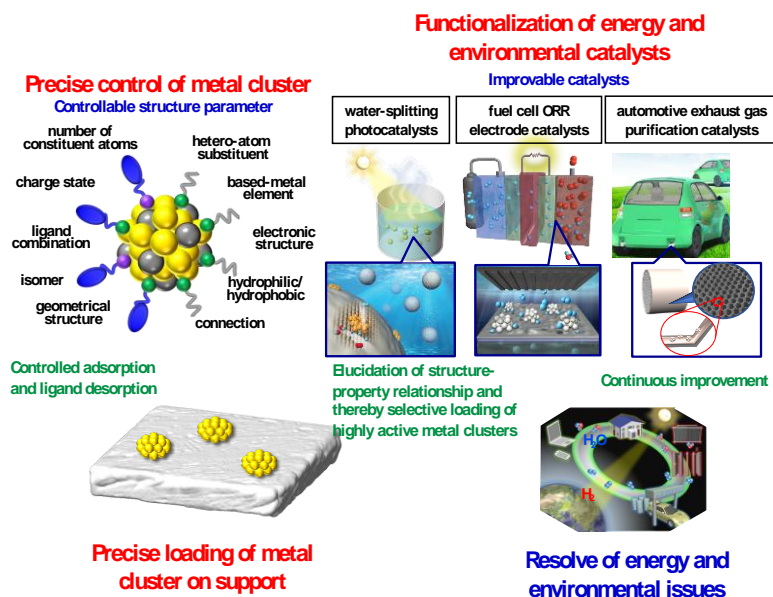
# Structure Control of Metal Clusters and Their Application in Energy and Environmental Catalysts

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In order to build a sustainable society, it is indispensable to create new innovative materials that can solve the problems of the current society. Strict control of the structure of materials at the nanoscale is expected to lead to the creation of such materials. Ultrafine metal clusters, in which several to several dozen metal atoms are aggregated, have novel electronic/geometric structures and physicochemical properties/functions that are different from those of bulk metals composed of the same elements. In addition, doping (alloying) of different elements to these metal clusters results in a variety of structures, properties, and functions. Thus, metal clusters have high potential as constituent units for innovative materials. However, in order to understand the functions of metal clusters and to apply them as materials, it is essential to establish techniques to strictly control the chemical composition and geometric structure of metal clusters. We have established several techniques to strictly control the chemical composition and geometric structure of metal clusters. We also succeeded in establishing a method to control the supported metal clusters to enhance the functionality of advanced water splitting photocatalysts, fuel cell electrocatalysts, and automotive exhaust gas purifying catalysts. Accordingly, we have achieved the highest water-splitting activity for UV-responsive  $\text{BaLa}_4\text{Ti}_4\text{O}_{15}$  water-splitting photocatalysts, created platinum electrocatalysts with higher catalytic activity for oxygen reduction than those currently used in fuel cells, and succeeded in developing highly functional catalysts for automotive exhaust gas purification. These our research is unique in that it consistently achieves the atomic-level control of the metal clusters throughout the entire research, from synthesis to control on the support. This presentation summarizes our recent works concerning these topics.



**Figure 1.** Graphical summary of the presentation.