# Preparation of Nanostructured Materials of Metal and Semiconductor and Applications to Functional Materials

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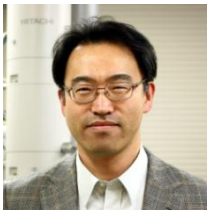
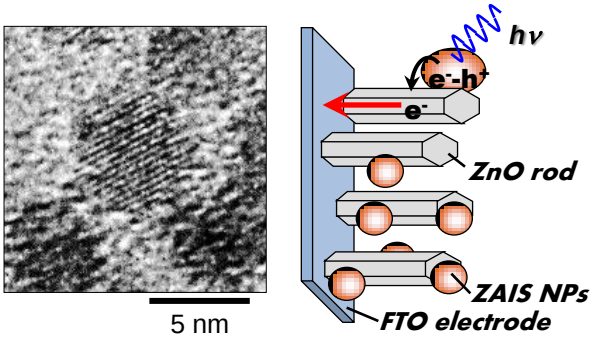


**Prof. Tsukasa Torimoto**

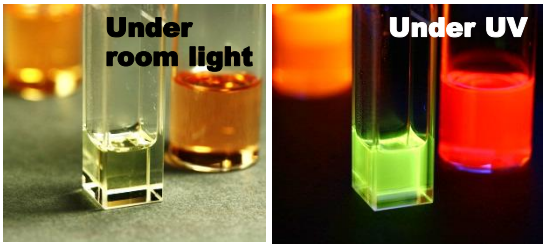
Metal and semiconductor nanoparticles exhibit unique physicochemical properties different from bulk materials or molecules, being dependent on their size and shape. We prepare novel materials having precisely-controlled nanostructures. The obtained materials will be used for applications of highly selective catalysts and photocatalysts, novel photoluminescent materials, solar cells, and optoelectronic devices.

## Preparation of semiconductor nanoparticles composed of low toxic elements and the application to photo-functional materials

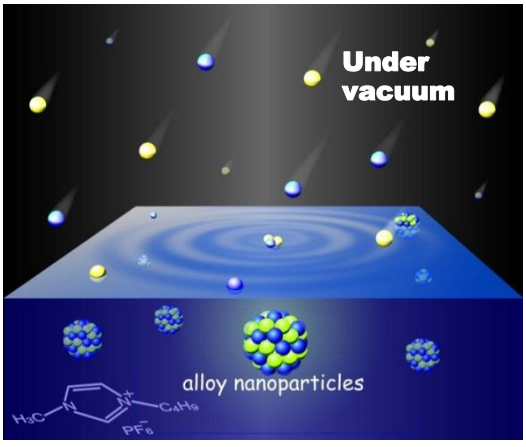
Novel semiconductor nanoparticles (NPs) of low toxic elements, such as $AgInS_2$ and $Cu_2ZnSnS_4$ are chemically synthesized via thermal decomposition reactions of precursors in an organic solution. The solid solution nanoparticles of $AgInS_2$ and ZnS exhibit intense photoluminescence, the peak wavelength being dependent on the composition of nanoparticles. These nanoparticles have an strong absorption band in the visible wavelength range. These unique properties enable the application to sensitized solar cells, bio-markers, or electroluminescent devices.




TEM image of ZAIS NPs and the application to sensitized solar cells.




Pictures of highly luminescent ZAIS NPs




Formation of alloy nanoparticles in ionic liquids under vacuum

## Syntheses of metal nanoparticles via sputter deposition of metal onto ionic liquids and the application to electrocatalysts

The sputter deposition of metals onto ionic liquids under vacuum enables the formation of metal nanoparticles. Alloy nanoparticles, such as AuAg, AuPd, and AuPt, are also formed by the simultaneous sputtering of different kind of metal targets. Thus-obtained particles are promising materials for electrocatalysts. Furthermore, the novel nanostructured particles having core-shell structure or hollow interior are fabricated by the modification of this technique.