

Controlled growth of high-density nanoparticles on zinc oxide thin films by photo-deposition

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Since Faraday in the 1850s, gold nanoparticles (AuNPs) have been the subject of growing interest. AuNPs are now commonly used in many applications such as sensors, photocatalysis, photovoltaic devices, and biological labeling.

The deposition of gold nanoparticles (AuNPs) on zinc oxide films a key step for (photocatalysis)catalysis or photovoltaic applications, still remains difficult to master.

The deposition of Au NPs on ZnO films was explored to achieve small AuNPs size and homogeneous shape, high areal density, high purity, and good chemical grafting with the metal oxide film. Among three possible methods to deposit AuNPs on ZnO—spin coating, deposition precipitation with urea and photodeposition (P-D) only P-D achieved good enough results to be useful for most applications. The modified P-D technique developed herein produces homogeneously and dispersed spherical Au NPs (7.5 ± 3 nm in diam.) with a high packing density (3500 ± 10 NPs/ μm^2). The high density of AuNPs has a direct impact on the activity of photocatalytic reactions. We demonstrate that high densities of Au NPs embedded within ZnO film enhance the production of hydrogen by photo- reduction of water. Furthermore, most of the AuNPs are intercalated into the 25 nm ZnO layer with only 1/5 of their volume emerging out of the metal oxide layer². While the confinement of nano-objects in small volume remains a great challenge in nanotechnologies in general, the photodeposition process is able to deposit AuNPs on ZnO thin films. This photodeposition process makes it of great interest for many applications needing high purity materials such as photovoltaics, photocatalysis, water purification, or biosensors.

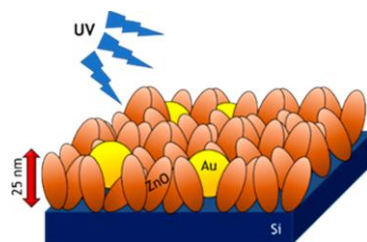


Figure 1. Representation of the high density of AuNPs obtained by deposition-precipitation (DP) for catalysis used for photocatalytic activity

References

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