Enzymatic Modulation of Shape of Gold Nanoparticles in Bioanalysis

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Abstract

Gold nanorods (AuNRs) are one of the most used nanostructures for biosensing and imaging applications due to their unique tunable optical properties.[1] In this work we present two examples of enzymatic modulation in the growth or shape of AuNRs, and its application for detection of biomolecules.

First, we selected the enzyme acetylcholinesterase (AChE), which hydrolyzes the substrate acetylthiocholine to produce the thiol-containing molecule thiocholine. This molecule is able to modulate the seed mediated growth of AuNRs, and different plasmon bands and/or gold nanoparticle shapes are obtained. On the basis of these results, a simple colorimetric assay[2] is proposed for the detection of subnanomolar concentrations of AChE inhibitors, which are analogs of nerve agents as shown in **Figure 1**. In the second case the enzymatic activity of horseradish peroxidase (HRP) in the presence of AuNRs and H_2O_2 has been used to trigger the chemical etching of AuNRs. Increasing amounts of H_2O_2 or HRP lead to a gradual reduction of the NR length while the thickness remained constant. When a sufficient amount of H_2O_2 or HRP was added, the rod-like shape was lost and spherical particles were obtained. The coupling of this reaction to the enzymatic reaction catalyzed by glucose oxidase (GOx), allowed us to develop a highly sensitive and simple colorimetric assay[3] that can be read out by the naked eye for the detection of physiological glucose concentrations in human serum as depicted in **Figure 2.**

References

[1] J. Pérez-Juste; I. Pastoriza-Santos; L.M. Liz-Marzán; P. Mulvaney, Coord.Chem. Rev., **249** (2005) 1870.
[2] M. Coronado-Puchau, L. Saa, M. Grzelczak, V. Pavlov, L.M. Liz-Marzán, Nano Today, **8** (2013) 461.
[3] L. Saa, M. Coronado-Puchau, V. Pavlov, L.M. Liz-Marzán, Nanoscale, **6** (2014) 7405.

Figures

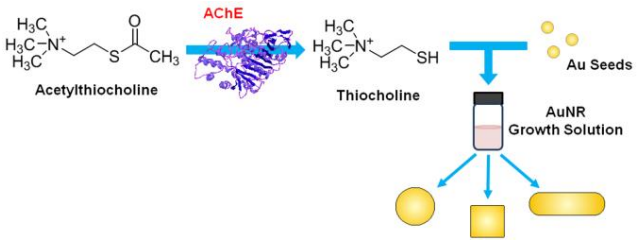

Figure 1. Enzymatic modulation of seed-mediated gold nanorod growth by AChE.

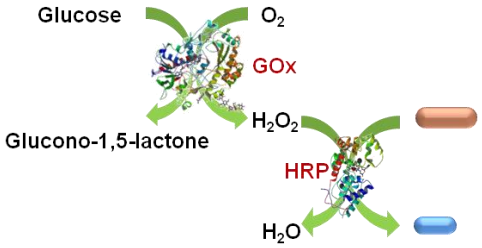

Figure 2. Enzymatic etching of AuNRs mediated by GOx and HRP.