Regulation of Silver Shell Growths on Gold Nanorods

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Abstract

In this research we are successfully synthesized gold nanorods (AuNRs) with aspect ratios (AR) of 2.5 (50X20 nm) with aromatic additives reductive 5-bromosalicyclic acid (5-BrSA) by seed-mediated growth method. 5-BrSA can also improve the monodispersity of AuNRs. The long axis absorbance peaks of this GNRs in UV-Vis spectra are 660 nm with the AR value 2.5, and the short axis peaks in UV-Vis spectra are about 500 nm. Further, the above AuNRs are used as seeds to synthesize gold-silver core-shell nanobars (Au@Ag NBs) by chemical reduction of silver ions at high temperature. The Au@Ag NBs with AR value of 1.45 (65X45X45) can be synthesized by AuNRs with AR value 2.5. The Au@Ag NBs have four absorption bands about 350, 400, 450 and 550 nm.

Introduction

The shape of the gold-silver nanoparticle is important, because the shell of the nanoparticle will influence the whole characteristic of the particle , like surface electricity , catalysis activity and the solubility, but also have affect to stability and distribute.And the UV-Vis spectra of core-shell Au-Ag nanoparticles can be tuned from NIR to visible region.

Experimental

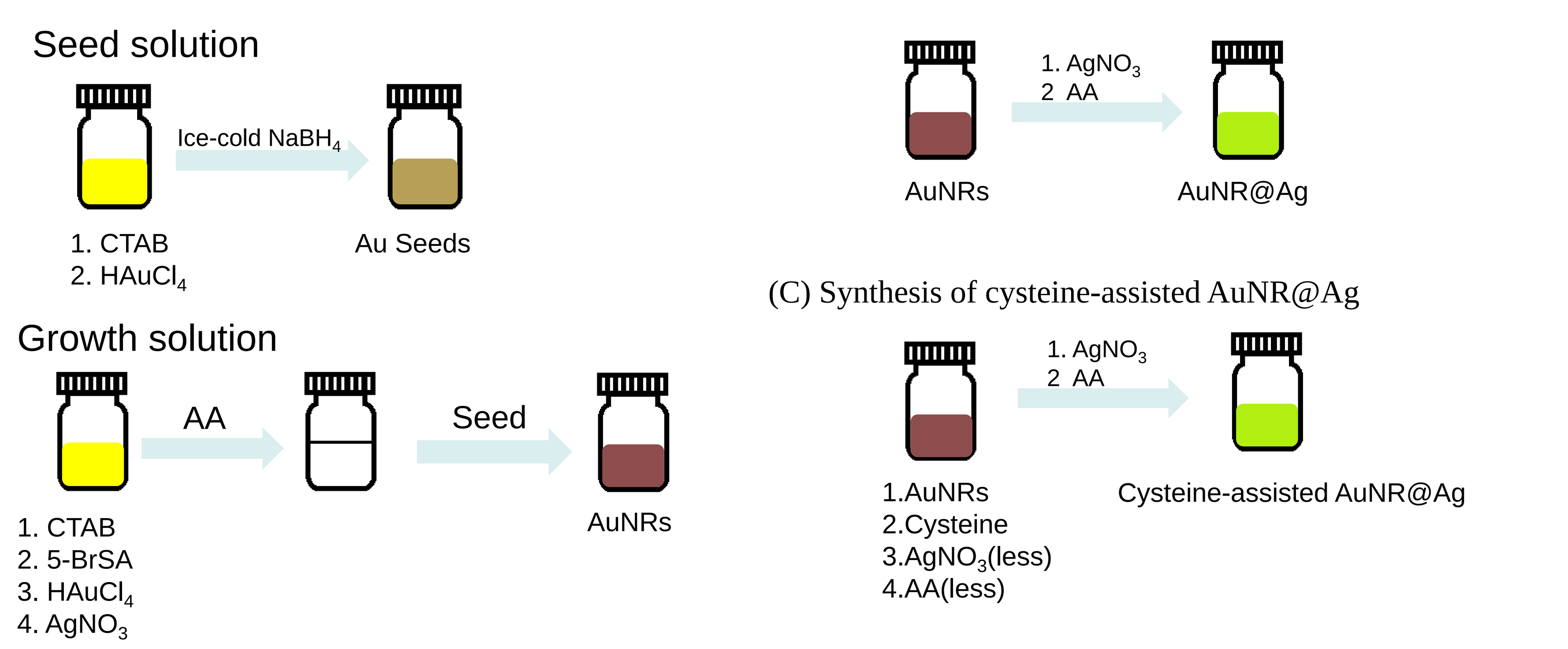

Figure 1. The Synthesis of AuNR and AuNR@Ag

Results and discussion

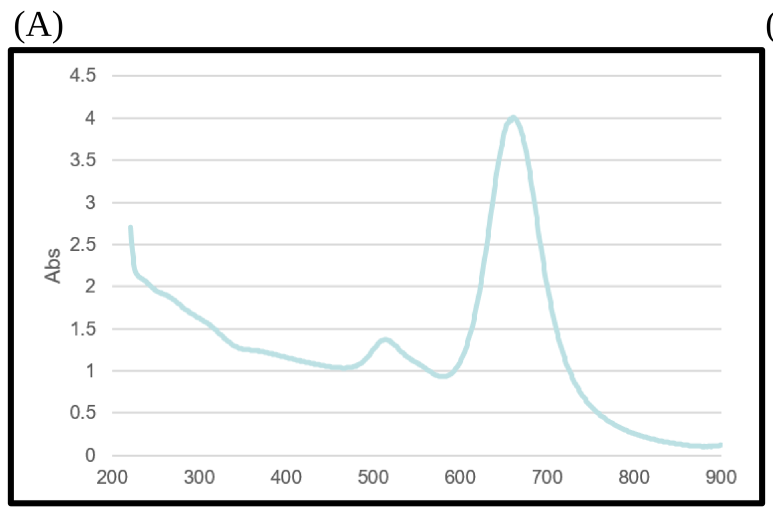

Figure 2. (A) The UV-vis spectra of AuNRs solution.

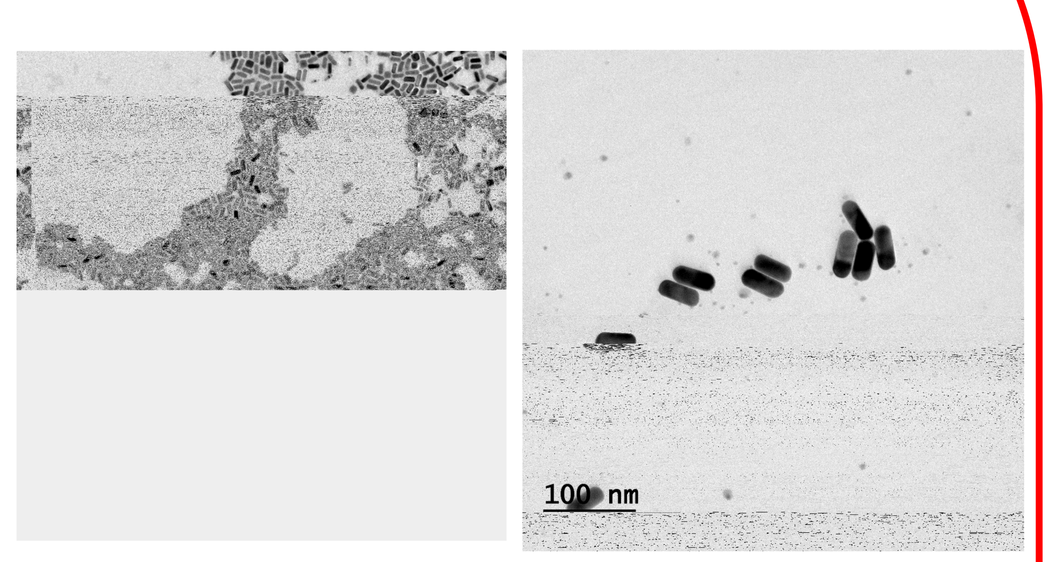

Fig (I) The TEM image of AuNRs

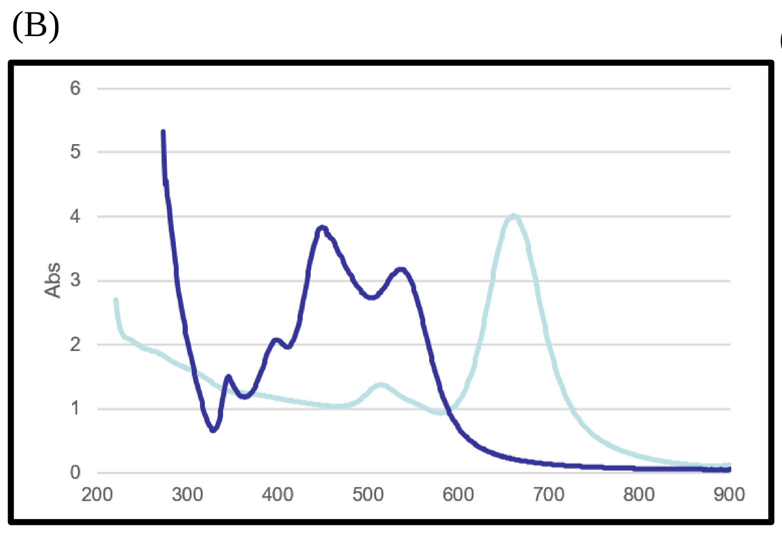

Figure 2. (B) The UV-vis spectra of AuNR solution and add $AgNO_3$ + AA after heating.

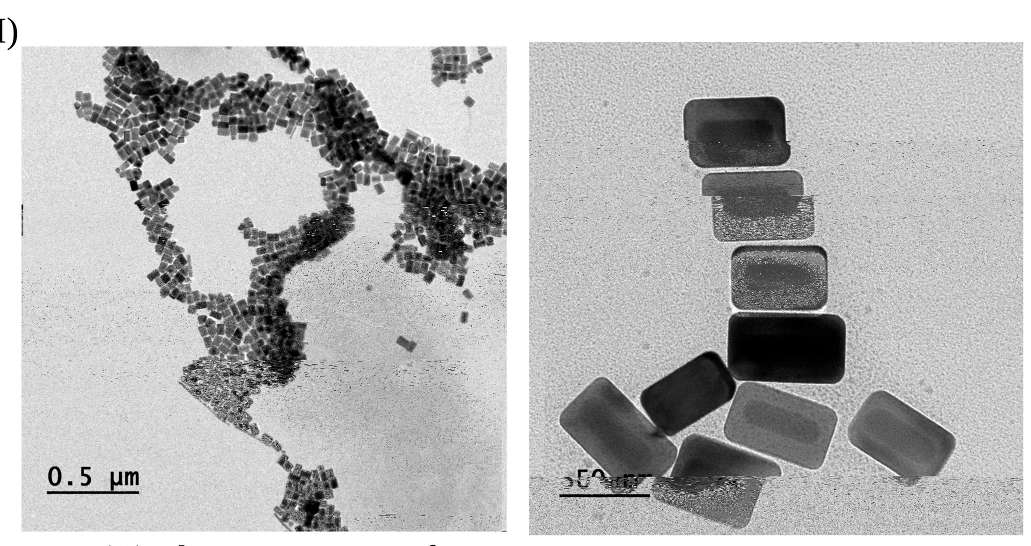

Fig (II) The TEM image of AuNR@Ag.

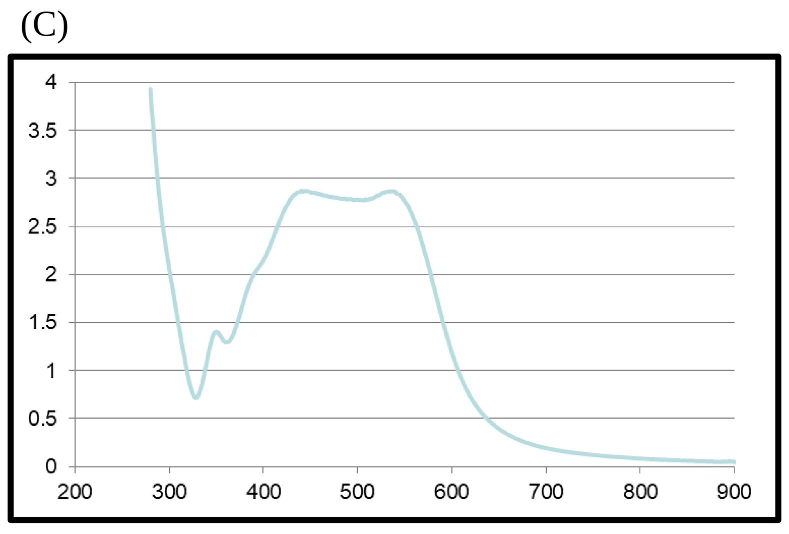

Figure 2. (C) The UV-vis spectra of cysteine-assisted AuNR (0.2 conc.) solution and add $AgNO_3$+AA after heating.

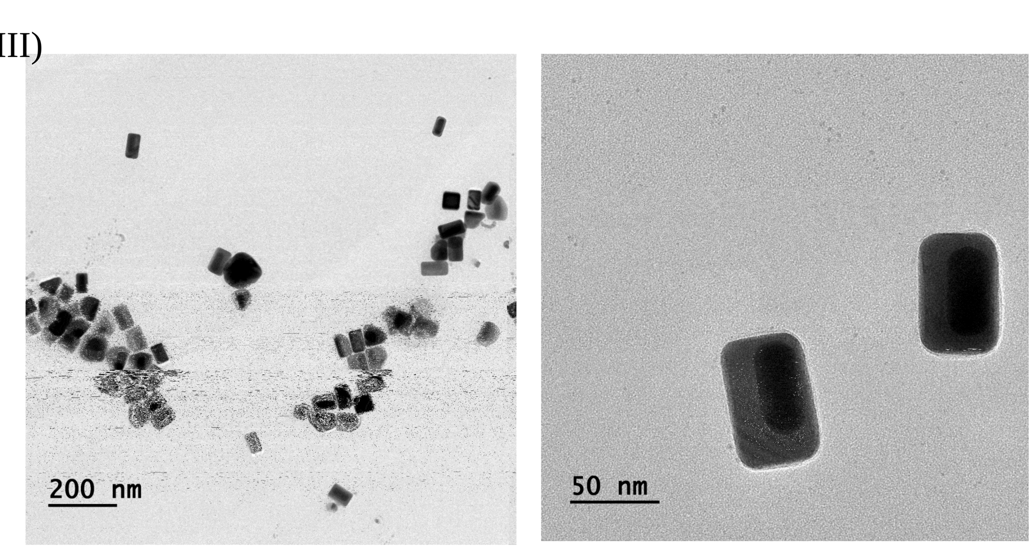

Fig (III) The TEM image of cysteine-assisted AuNR (0.2 conc.)@Ag.

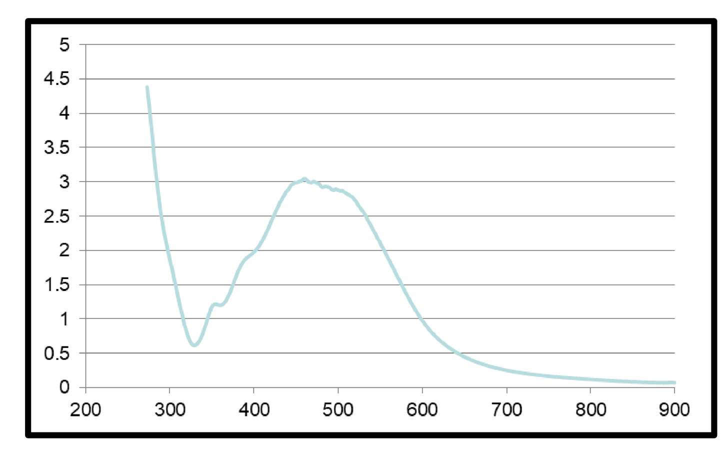

Figure 2. (D) The UV-vis spectra of cysteine-assisted AuNR (0.1 conc.) solution and add $AgNO_3$ + AA after heating.

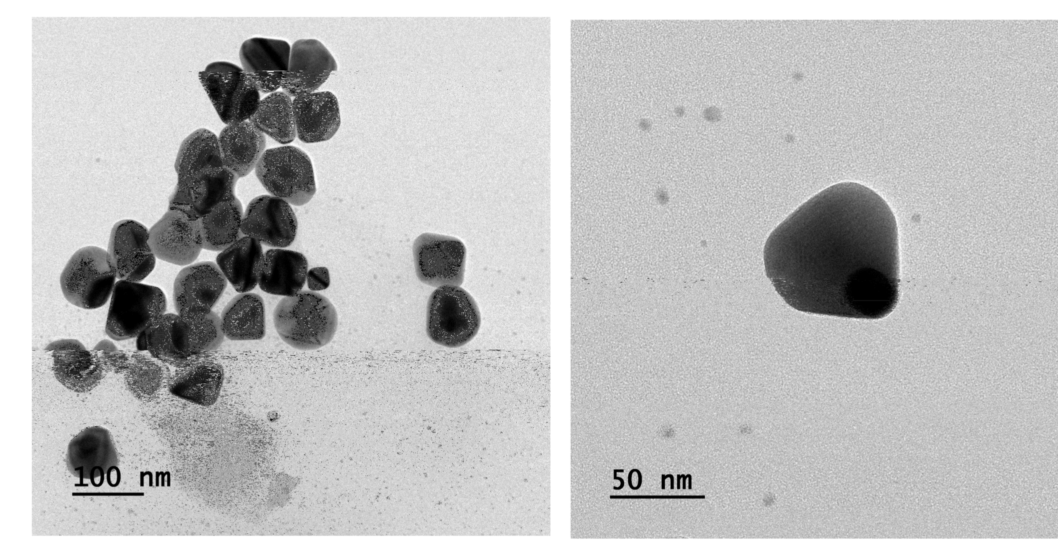

Fig (IV) The TEM image of cysteine-assisted AuNR (0.1 conc.)@Ag.

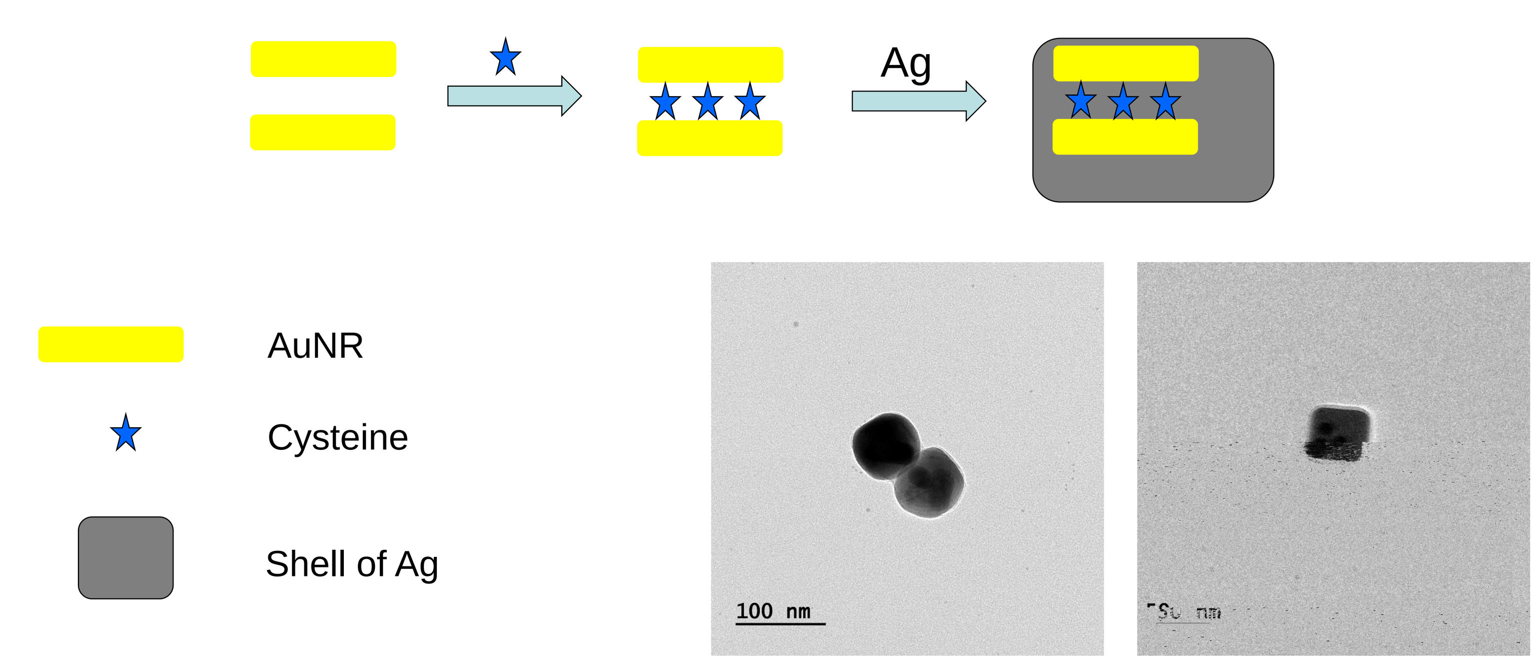

Figure 3. The influence of cysteine-assisted gold nanorods in silver shell.

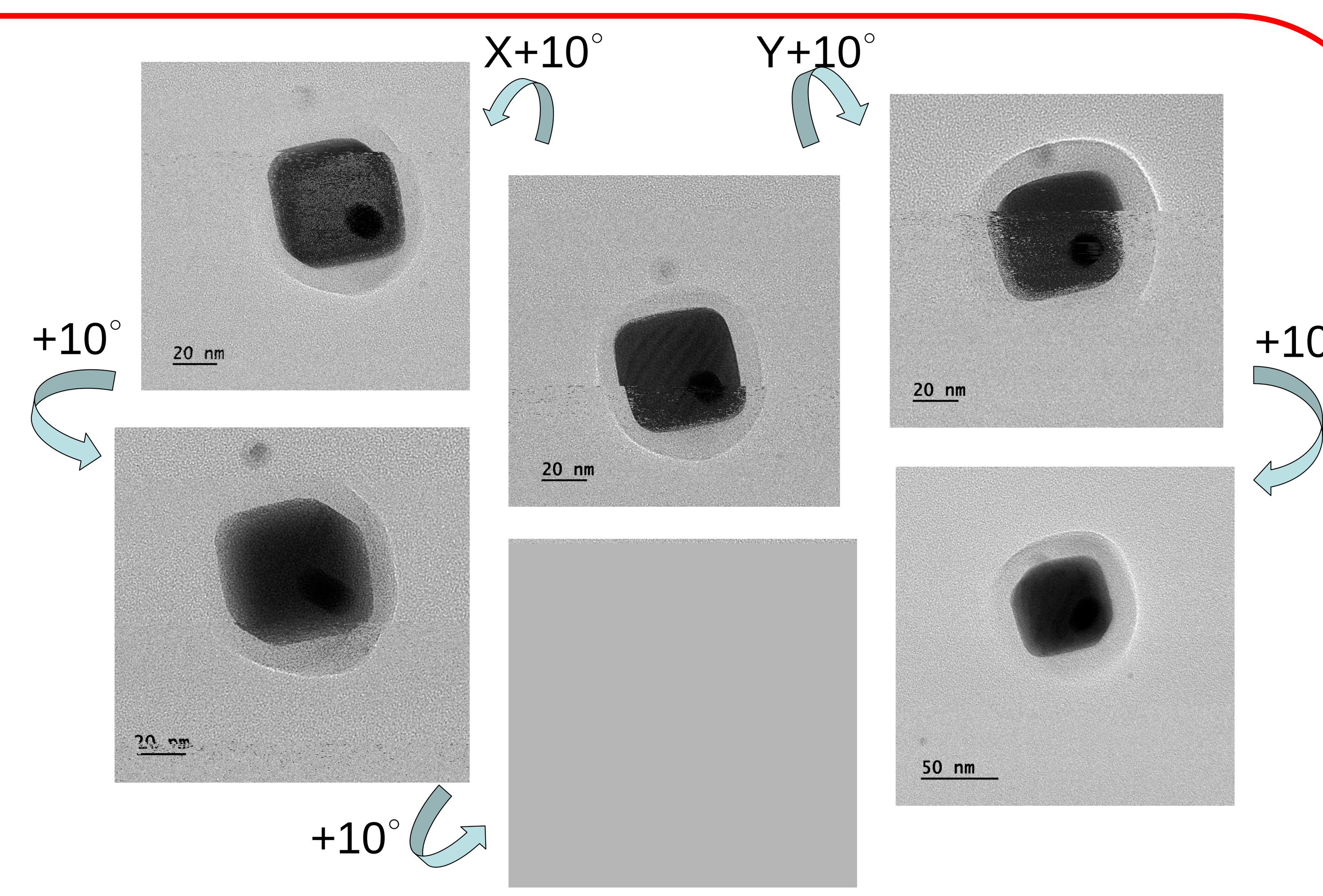

Figure 4. TEM image through tilt to change the degree for measuring AuNRs@Ag

Conclusion

We have demonstrated that AuNR@Ag can be successfully synthesized from gold nanorod seeds with cysteine additives by a two-step process of reaction temperatures. We discover that the addition of cysteine is essential to the formation of AuNR@Ag core-shell nanobars in which gold nanorods are in the corner positions of the nanobars, and the distance between of cysteine-assisted gold nanorods may more close than normal gold nanorods.

Reference

1. Nikoobakht, B. and El-Sayed, M. A. *Chem. Mater.*, **2003**, *15*, 1957-1962
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3. Ye, X.; Jin, L.; Caglayan, H.; Chen, J.; Xing, G.; Zheng, C.; Doan-Nguyen, V.; Kang, Y.; Engheta, N.; Kagan, C. R. and Murray, C. B. *ACS Nano*, **2012**, *6*, 2804-2817