Colloids and Surfaces A: Physicochem. Eng. Aspects 414 (2012) 492–497

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

journal homepage: www.elsevier.com/locate/colsurfa

High-purity gold nanobipyramids can be obtained by an electrolyte-assisted and functionalization-free separation route

Zhirui Guo[a], Yu Wan[b], Meng Wang[b], Lina Xu[b], Xiang Lu[a,*], Guang Yang[b], Kun Fang[b], Ning Gu[b,**]

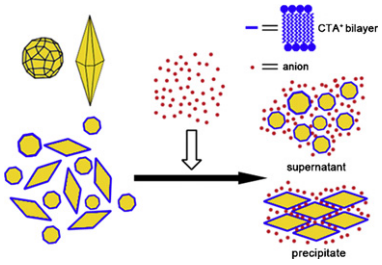
[a] The Second Affiliated Hospital of Nanjing Medical University, Nanjing 210011, China
[b] Jiangsu Key Laboratory for Biomaterials and Devices and State Key Laboratory of Bioelectronics, Southeast University, Nanjing 210096, China

HIGHLIGHTS

- Gold nanobipyramids with a purity of over 90% were firstly reported.
- The nano-mixtures subjected to shape-selective aggregation after adding salt.
- The aggregation of nanobipyramids was reversible and the reason was discussed.

GRAPHICAL ABSTRACT

.



ARTICLE INFO

Article history:
Received 31 May 2012
Received in revised form 24 July 2012
Accepted 26 July 2012
Available online 10 August 2012

Keywords:
Gold nanobipyramid
Shape
Electrostatic screening
Contact area

ABSTRACT

Gold nanobipyramids (NBPs) have attracted intensive attentions because they exhibit more advantageous plasmonic properties than comparable gold nanorods. However, unlike that short gold nanorods can be synthesized routinely in a high yield (around 99% of the total particles), current syntheses of gold NBPs generally receive a low yield (around 30% of the total particles) and co-produce spherical impurities difficult to separate. Thus an effective purification route of gold NBPs is desirable for optimizing their performances. In this study, we demonstrated that the spherical nanoparticles with smaller inter-particle contact area can be separated from the NBPs that undergo gradual precipitation by electrolyte-induced electrostatic screening. During this procedure, no special surface-functionalization of the NBPs was needed. As a result of this simple separation strategy, NBPs at a level of purity to above 90% is achieved in a single purification round. In particularly, the precipitates of cetyltrimethylammonium bromide (CTAB)-capped NBPs can be easily converted into colloidal state due to the strong steric constraint of CTA^+ bilayer, facilitating further investigations.

1. Introduction

Control over the shape of noble metal nanocrystals has received growing interests because their plasmonic properties are highly shape-dependent [1–3]. Among numerous solution-based synthetic methods, preformed-seed-mediated growth has proven to be extremely powerful for the synthesis of a wide variety of multiply shaped nanocrystals with narrow size distribution [4,5]. For a case of seeding growth, shape-directing agent such as surfactant, polymer and foreign ion, is indispensable for breaking the symmetry of face-centered cubic noble metal to induce nonspherical structures [6–9]. On the other hand, the crystal type of the seeds is also important for shape evolution. An example can be given for the growth of elongated gold nanocrystals in the presence of cetyltrimethylammonium bromide (CTAB) and silver ions. When single-crystal seeds are used, the well-known short nanorods with a spectacular yield are obtained [10,11]. Interestingly, when the multiply-twinned seeds are exploited, bipyramid-shaped nanoparticles (NBPs) with twinned boundaries around the long axis are

* Corresponding author. Fax: +86 25 83575057.
** Corresponding author. Fax: +86 25 83272476.
E-mail addresses: luxiang1966@gmail.com (X. Lu), guning@seu.edu.cn (N. Gu).

0927-7757/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.colsurfa.2012.07.034