Colloids and Surfaces A: Physicochem. Eng. Aspects 414 (2012) 50–56

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

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

Asymmetric gold nanoparticles synthesized in the presence of maltose-modified poly(ethyleneimine)

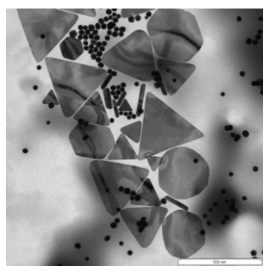
Anja Köth[a], Dietmar Appelhans[b], Claudia Prietzel[a], Joachim Koetz[a,*]

[a] Universität Potsdam, Institut für Chemie, Karl-Liebknecht-Strasse 24-25, Haus 25, 14476 Potsdam (Golm), Germany
[b] Leibniz-Institut für Polymerforschung Dresden e.V., Hohe Strasse 6, 01069 Dresden, Germany

HIGHLIGHTS

- ▶ Asymmetric gold nanoparticles synthesized in a tubular template phase.
- ▶ Maltose-modified PEI used for the transformation of the template phase.
- ▶ Maltose-modified PEI as reducing and stabilizing agent for the gold nanoparticles.
- ▶ Nanostructured gold triangles, hexagons and long bent rods.
- ▶ Thin gold triangles consisting of {1 0 0} and {1 1 1} facets.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 25 April 2012
Received in revised form 18 July 2012
Accepted 5 August 2012
Available online 15 August 2012

Keywords:
Gold triangles
Hexagons and nanorods
Tube-like template phase
Maltose-modified PEI

ABSTRACT

A self-assembled tube-like network, spontaneously formed by adding maltose-modified poly(ethyleneimine) (mal-PEI5000) to mixed phospholipid vesicles, can be used as a template for the formation of gold nanoparticles. High resolution TEM indicates that the growing process leads not only to the formation of spherical gold nanoparticles with an absorption maximum at 520 nm, but also very flat triangles, hexagons, and long bent rods are formed, revealing an absorption maximum in the NIR at about 850 nm.

One can conclude that nanorods, nanotriangles and nanohexagons are predominantly formed in the tubular network structure.

1. Introduction

The synthesis of gold nanoparticles has been of interest, starting with investigations of "soluble" gold, appeared around the 5th or 4th century B.C. in Egypt and China to make ruby glass or coloring ceramics. In the Middle Ages colloidal gold sols were used for various diseases, such as heart and venereal problems, epilepsy, and for diagnosis of syphilis. In 1857 Faraday reported the formation of colloidal gold solutions by reduction of chloroaureate using phosphorus in CS_2, and described the optical properties of resulting films [1].

In 1951 Turkevich et al. [2] produced spherical gold nanoparticles in aqueous solution by using citric acid as reducing agent, and 1994 Brust et al. [3] have shown that ultrafine Au nanoparticles can be produced in organic solvents.

During the last 20 years, gold nanoparticle chemistry and physics has emerged as a new subdiscipline in colloidal research because of the extraordinary electronic, optical and catalytic properties of stable noble metal nanoparticles in the size range between 1 and 10 nm [4–7]. The unusual properties of small gold nanoparticles, the size dependent electrochemistry, and their high chemical stability have made them the system of choice in different fields

* Corresponding author at: University Potsdam, Institute of Chemistry, Karl-Liebknecht-Strasse 24-25, Haus 25, D-14476 Potsdam, Germany.
Tel.: +49 3319775220; fax: +49 3319775054.
E-mail address: koetz@uni-potsdam.de (J. Koetz).

0927-7757/$ – see front matter
http://dx.doi.org/10.1016/j.colsurfa.2012.08.004