Journal of Nano Research Vol. 14 (2011) pp 47-55
Online available since 2011/Apr/14 at www.scientific.net

doi:10.4028/www.scientific.net/JNanoR.14.47

One-Pot Synthesis of Coral-Shaped Gold Nanostructures for Surface-Enhanced Raman Scattering

Jianhui Yang and Dhiraj K. Sardar[1, a]

[1]Department of Physics and Astronomy, University of Texas at San Antonio, San Antonio, Texas 78249

adsardar@utsa.edu

Submitted: September 06, 2010; revised: October 28, 2010; accepted: November 24, 2010

Keywords: synthesis, gold, nanostructures, surface-enhanced Raman spectroscopy

Abstract. In this work, a chelating agent, ethylenediaminetetraacetic acid (EDTA) was used for the controllable synthesis of gold nanostructures in aqueous solution. Coral-shaped Au nanostructures were synthesized by reducing $HAuCl_4$ with EDTA. EDTA serves not only as a reducing agent but also as a particle capping agent in the formation of coral-shaped Au nanostructures. It is found that the molar ratio of $HAuCl_4$:EDTA and reacted temperature play significant effects on the formation and growth of these novel nanostructures. These Au nanostructures could serve as highly sensitive and reproductive surface-enhanced Raman scattering (SERS) substrates for chemical and biological detection.

Introduction

Noble metal nanostructures have attracted considerable attentions because of their various applications such as imaging, catalysis, sensing, surface-enhanced Raman scattering (SERS), diagnostic, and therapy [1-7]. Shape-control provides an important strategy for designing metallic nanostructures to tailor their physical and chemical properties [8-11]. For example, in the case of localized surface plasmon resonance (LSPR) and SERS, both computational and experimental studies have demonstrated that the shape of Au nanocrystals play the most important roles in determining the number, position, and intensity of LSPR modes, as well as the spectral region or polarization dependence for effective molecular detection by SERS [12,13]. Therefore the synthesis of Au nanostructures with well-controlled morphology is important for developing their practical applications [14-17]. A number of approaches have been reported for synthesizing gold nanoparticles with various non-spherical shapes including rods, wires, plates, belts, shells, and multipods [18-23]. Although much progress has been made on shape-controllable synthesis of gold nanostructures, it is significantly more challenging to develop facile and effective solution approaches for systematic manipulation of the shape of Au nanostructures.

EDTA is a member of the polyamino carboxylic acid family of ligands, which is widely used in titration, analysis, separation and therapy because of its role as a chelating agent, i.e. its ability to "sequester" metal ions [24]. Nevertheless relatively little attention has been paid on the synthesis of metallic nanoparticles using EDTA as reducing agent [25-28]. In this article, we report a facile strategy for one-pot synthesis of coral-shaped Au nanostructures using EDTA as reducing agent. Preliminary mechanisms have been proposed to account for the formation of these nanostructures. Moreover, these Au nanostructures show excellent SERS enhancement ability, which could serve as highly sensitive and reproductive SERS substrates for chemical and biological detection. In contrast to previous reports, the advantage of the proposed strategy includes simplicity, high yield, and good reproducibility. The coral-shaped Au nanostructures can provide several hot spots on a single particle, which significantly increases SERS enhancement [29].