Chemical Engineering Journal 214 (2013) 253–261

Contents lists available at SciVerse ScienceDirect

Chemical Engineering Journal

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

Recovery of microbially synthesized gold nanoparticles using sodium citrate and detergents

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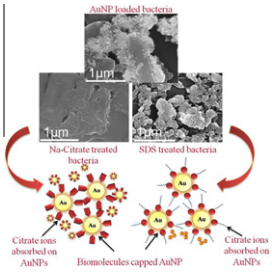
HIGHLIGHTS

- Au nanoparticles were synthesized at room temperature using marine bacterium *Jeotgalibacillus* sp.
- CTAB did not recover nanoparticles.
- 1 mM citrate recovered small nanoparticles (5–35 nm).
- SDS extracted large nanoparticles (80 nm).
- Purified nanoparticles were separated easily by centrifugation.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 18 July 2012
Received in revised form 20 October 2012
Accepted 22 October 2012
Available online 10 November 2012

Keywords:
AuNPs
Biosynthesis
Sodium citrate
SDS
Size-specific recovery
Well dispersed AuNPs

ABSTRACT

Though microbial synthesis of metal nanoparticles are considered to be cost-effective, non-toxic, and eco-friendly method, the entrapment of many nanoparticles in the biomass after the reaction is a major drawback in their use for nanoparticle fabrication. Therefore, a protocol needs to be developed for efficiently recovering the nanoparticles from the biomass pellet. Surfactants such as cetyltrimethylammonium bromide (CTAB), sodium dodecyl sulfate (SDS), and sodium citrate have been used as capping and reducing agents. Current study reports the fact that CTAB, SDS and sodium citrate can also be used for successful recovery of Au nanoparticle (AuNP) from microbial biomass like marine bacterium *Jeotgalibacillus* sp. and that during recovery the shift in size of AuNPs takes place. Results demonstrated that different concentrations of SDS and sodium citrate could extract a noticeable amount of gold nanoparticles (AuNPs). UV–Vis spectroscopy and transmission electron microscopy (TEM) analysis revealed that concentration of AuNPs extracted increased with increasing concentration of sodium citrate and SDS. 1 mM of sodium citrate extorted smaller AuNPs whereas higher concentrations recovered larger AuNPs. In contrast, all concentrations of SDS specifically recovered large AuNPs. Field-emission scanning electron microscopy (FESEM) and energy dispersive X-ray (EDAX) analysis documented the presence of pure Au adhered to the surface of the bacterial cells. Inductively coupled plasma (ICP) analysis showed that 75% of the AuNPs could be recovered using sodium citrate and SDS. AuNPs recovered were stable in solution. This is the first report on the purification of AuNPs from bacterial cells.

1. Introduction

Nanoscience is a prodigious field that is currently being touted as having the potential to greatly improve human life. Nanoparticles possess a wide range of applications such as electronics, cosmetics, coatings, packaging, and biotechnology [1]. The synthesis and application of gold nanoparticles (AuNPs), in particular, has been one of the most cherished subjects of research for many decades [2]. AuNPs are of significant interest due to their unique physical and chemical properties, biological compatibility and possible applications [3]. The current technologies for the efficient synthesis of monodispersed, size-controlled nanoparticles are limited to clinical studies due to high cost, instability and the use of toxic chemicals [4]. Biological means of nano-metal fabrication provide an attractive means to overcome these limitations and develop

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http://dx.doi.org/10.1016/j.cej.2012.10.028