SYNTHESIS OF GOLD NANOPARTICLES USING PLANT EXTRACTS AND ITS ANALYTICAL APPLICATION

Thesis Submitted
By

Fatma Husen EL Magdob
B.Sc. (Chemistry) 2000

To
CHEMISTRY DEPARTMENT
FACULTY OF SCIENCE
AIN-SHAMS UNIVERSITY

For
THE DEGREE
M.Sc. IN CHEMISTRY
(2012)

Thesis Advisors

Prof. Dr. Moustafa M. H. Khalil
Professor of Inorganic and Analytical
Faculty of Science, Ain Shams University

Dr. Eman H. Esmail
Assistant Professor of Inorganic and Analytical
Faculty of Science, Ain Shams University

Approval Sheet

Name of candidate: **Fatma Husen El magdob**
Degree: M.Sc. Degree in Chemistry

Thesis Title: SYNTHESIS OF GOLD NANOPARTICLES USING PLANT EXTRACTS AND ITS ANALYTICAL APPLICATION

This Thesis has **been approved by:**

1- Prof. Dr, Moustafa M. H. Khalil

2- Dr. Eman H. Esmail

Approval

Chairman of Chemistry Department

Prof. Dr. Maged Shafik Antonious Nakhla

SYNTHESIS OF GOLD NANOPARTICLES USING PLANT EXTRACTS AND ITS ANALYTICAL APPLICATION

By

Fatma Husen El Magdob
B.Sc. (Chemistry) 2000
Under the supervision of:

Prof. Dr. Moustafa M. H. Khalil

Chemistry Department, Faculty of Science, Ain Shams University,
Abbasia, Cairo, Egypt

Dr. Eman H. Esmail

Chemistry Department, Faculty of Science, Ain Shams University,
Abbasia, Cairo, Egypt

Acknowledgement

First I do thank Allah the most merciful for his indefinite blessings

I am indebted to ***Prof. Dr. Mostafa M. H. Kalil,*** *Professor of Inorganic and Analytical, Faculty of Science, Ain Shams University, for suggesting the theme of this study, for the help and guidance he has given during his supervision of this work and without which fulfillment of this work would be impossible, for helping and revising the whole manuscript.*

Many thanks to ***Dr. Eman H. Esmail,*** *Assistant Professor of Inorganic and Analytical, Faculty of Science, Ain Shams University, for her help and supervising the practical work and for her guidance and support in writing the thesis.*

Fatma Hussien

CONTENTS

LIST OF FIGURES

Fig No. **List of Figures** **Page**

LIST OF TABLES

ABSTRACT

Biological synthesis of gold nanoparticles (Au NPs) of various shapes (triangle, hexagonal, spherical) using hot water olive leaf, grape leaf, pomegranate peel and grape seed extract as reducing agent are reported. This is a simple, cost-effective, stable for long time and reproducible aqueous room temperature synthesis method to obtain a self-assembly of (AuNPs).The size and shape of Au nanoparticles are modulated by varying the ratio of metal salt and extract in the reaction medium. Only 30 minutes were required for conversion to gold nanoparticles at room temperature and suggesting reaction rate higher or comparable to those of nanoparticles synthesis by chemical methods. Variation of pH of the reaction medium gives Au NPs nanoparticles of different shapes. The nanoparticles obtained are characterized by UV–vis, photoluminescence, transmission electron microscopy (TEM), X-ray diffraction (XRD), FTIR spectroscopy and thermo gravimetric analysis. TEM images showed that a mixture of shapes (triangles, hexagonal and spherical) structures were formed at lower olive leaf, grape leaf, pomegranate peel and grape seed extract broth concentration and high pH, while smaller spherical shapes were obtained at higher extract broth concentration and low pH.

Keywords
Biosynthesis, gold nanoparticles (olive leaf, grape leaf and grape seed) extract, antioxidant.

Introduction

1. Nanoparticles:

One of the first and most natural questions asked when starting to deal with nanoparticles is “Why are nanoparticles so interesting? Why work with these extremely small structures that are challenging to handle and synthesize especially when compared with their macroscopic counterparts?” The answer lies in the unique properties possessed by these nanoparticles.

The term nano is adapted from the Greek word meaning “dwarf.” When used as a prefix, it implies 10^{-9}m. A nanometer (nm) is one billionth of a meter, or roughly the length of three atoms side by side. A nanoparticle is a microscopic particle with at least one dimension less than 100 nm. Nanoparticles are of great scientific interest as they bridge the gap between bulk materials and atomic or molecular structures. A bulk material has constant physical properties regardless of its size, but at the nanoscale this is often not the case. Several well characterized bulk materials have been found to possess most interesting properties when studied in the nanoscale. There are many reasons for this including the fact that nanoparticles possess a very high aspect ratio. Accurate controls of size, composition, morphology, and stability and the use of environment-friendly procedures are highly desirable for the synthesis of nanoparticles. Noble metal nanocrystals are particularly important because of their chemical stability and interesting optical properties that can be customized through control over particle size, shape, composition, and morphology (**Sawle et al., 2008**).

Metallic nanoparticles have possible applications in diverse areas such as electronics, cosmetics, coatings, packaging, and biotechnology. For example, nanoparticles can be induced to merge into a solid at relatively lower temperatures, often without melting, leading to improved and easy-to-create coatings for electronics applications (eg, capacitors). Typically, nanoparticles possess a wavelength below the critical wavelength of light. This renders them transparent, a property that makes them very useful for applications in cosmetics, coatings, and packaging. Metallic nanoparticles can be attached to single strands of DNA nondestructively. This opens up avenues for medical diagnostic applications. Nanoparticles can traverse through the vasculature and localize any target organ. This potentially can lead to novel therapeutic, imaging, and biomedical applications. Based on all of the above, the synthesis of metallic nanoparticles is an active area of academic and, more importantly, “application research” in nanotechnology.

1.2 Chemical Methods of preparation:

There are two alternative approaches for synthesis of metallic nanoparticles: the “bottom-up” approach and the “top-down” approach. Bottom-up, or self assembly, refers to the construction of a structure atom-by-atom, molecule-by-molecule, or cluster-by-cluster. In this approach, initially the nanostructured building blocks (ie, nanoparticles) are formed and, subsequently, assembled into the final material using chemical or biological procedure(s) for synthesis. A distinct advantage of the bottom-up approach is the enhanced possibility of obtaining metallic nanoparticles with comparatively lesser defects and more homogeneous chemical composition(s). In the top-down approach, a suitable starting material is reduced in size using physical (eg, mechanical) or chemical means. A major drawback of the top-down approach is the imperfection of the surface structure. Such defects in the surface structure can have a significant impact on physical properties and surface chemistry of the metallic nanoparticles due to the high aspect ratio.

The traditional and most widely used methods for synthesis of metallic nanoparticles use wet-chemical procedures. A typical procedure involves growing nanoparticles in a liquid medium containing various reactants, in particular reducing agents (eg, sodium borohydride **(Kim et al., 2007)** or