Short Research Article

Microwave Synthesis and characterization of Gold Nanoparticles with Tamarindus Indica Seed Gum

Abstract

In recent work established a well-systemized focus was on- synthesis, capping, stabilizing and characterization of gold nanoparticles. For this we used tamarind seed gum as capping and stabilizing agent for gold nanoparticles AuNPTSG were confirmed by UV, IR, XRD and TEM spectral studies. Particle size dispersal curve reveals that nanoparticles obtained are polydispersed in nature having average diameter 12 nm An innovative viable little cost methodology was used to synthesize the AuNPTSG. AuNPTSG were produced by the use of naturally occurring tamarind seed gum which act as both as reducing and stabilizing agent. Water was used as ecologically safe solvent.

Keywords: Green synthesis, Tamarind Seed Gum, Gold Nanoparticles, Microwave and Nanotechnology research.

Introduction

Nanotechnology is forthcoming research field taking enormous benefits in science and technology for the purpose of industrialized novel materials at the nanoscale level [1]. Nanotechnology is the branch of science and technology, which deals with the production of materials in size less than 100 nm scale as nanoparticles. In the last two decades, nanoparticle research has developed one of the most significant areas in current materials science research [2-3]. The initiation of production of huge advanced nanotechnology encourages the usage of noble metal-based NPs for diagnosis of diseases, selected drug delivery, biological treatment of cancerous cells, and bio-imaging. It has fascinated significant attentiveness in the fields of catalysis, electronics and medicine, due to the unique properties of nanoparticles, such as catalytic, optical, antimicrobial and cancer therapeutic properties [4-9]. The worldwide market takes an extraordinary demand for nanoparticles, and it is estimated that this demand will reach 98 billion dollars by 2025 [9].

AuNPs are proposed for use as conductors from inkjet printer to electronic chips. AuNPs are being useful in to bonding resistors, conductors, and other elements of an electronic chip [7]. When light is severe to a tumor containing AuNPs, the particles quickly heat up, killing tumor cells in a treatment also known as hyperthermia therapy [8]. Efficient fluorescence extinction and surface plasmon resonance absorption are the significant features of AuNPs which have been applied in photodynamic therapy [9]. Vital properties of AuNPs such as special physicochemical, optical, biocompatibility properties, functional flexibility, tunable monolayers, controlled dispersity, high surface area for loading the density of drugs, stability and nontoxicity make them an efficient nanocarrier in drug delivery systems [10]. AuNPs are used in a wide range of sensors. Such as, a based-on color identifier of AuNPs can identify, if foods are suitable for consumption. Other techniques, for example surface enhanced Raman spectroscopy, exploit AuNPs as substrates to allow the measurement of vibrational energies of chemical bonds. This approach could also be functional for the finding of proteins, pollutants, and other molecules label-free [11].

Synthesis of AuNPTSG using microwave oven at 450 W for 5mins. In present study the focus was on- synthesis, capping, stabilizing and characterization of AuNPTSG. For this we used tamarind seed gum as capping and stabilizing agent. During Microwave conditions, the tamarind seed gum expands and its functional groups becomes more susceptible to react with gold ions.

Experimental

Materials

Auric Chloride Trihydrate $AuCl_3.3H_2O$, Rhodamine 6G and Tamarindus Seed gum collected from seeds of Tamarind tree at Sree Dattha Group Institutions, Sheriguda, Telangana and India. Throughout the reaction used Milli.Q water.

Synthesis of AuNPTSG:

About 40ml (0.4 to 0.2 mM) of aqueous solution $HAuCl4.3H_2O$ was taken in a 100 ml beaker and added 200 ml of (0.2 to 0.4%) aqueous solution of TSG. The synthesis was preceded in a microwave oven at a 350 W for 10 min the reaction.

Results and Discussion

UV-visible Spectral analysis of AuNPTSG

Addition of $HAuCl_4$ solution to TSG results in exhibiting the yellow color and was kept in Microwave oven at 450W, which turned to intense purple color within 12min, confirming the synthesis of AuNPTSG. The UV-Vis absorption spectra of AuNPTSG synthesis by different time intervals (15-35min) **Figure. 1** It is observed that, as the concentration of HAuCl4 solution increases, there is a progressive enhancement in the intensity of the Surface plasma resonance band (SPR), which indicates, the increased formation of AuNPTSG. The absorbance maximum was observed in the range of 525–530 nm, which is characteristic of gold surface Plasmon resonance [6]. As the concentration of TSG increases, there is a progressive enhancement in the intensity of the SPR band, which indicates the increased formation of AuNPTSG.

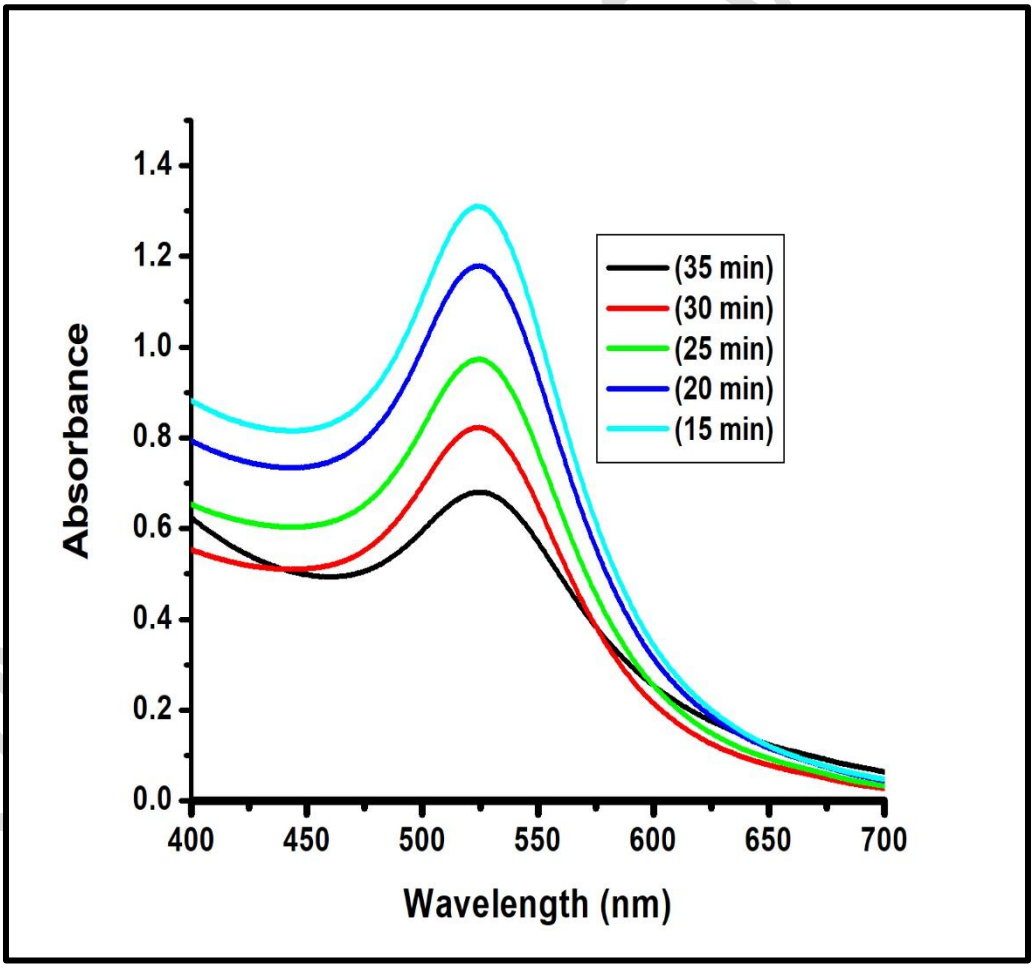

Figure 1. UV-Visible absorption spectra of AuNPTSG **w**ith various time intervals (15-35min)

FTIR analysis of AuNPTSG

FTIR spectrum shows possible biomolecules in TSG responsible for the reduction and stabilization of AuNPTSG. **Figure. 2** has shown bands at 3410, 2226, 1658, 1396, and 715 cm^{-1}. The broad band at 3410 cm^{-1} attributed to the –OH groups of the polysaccharides of the TSG (Oueslati et al. 2020), a weak and broad peak at 2226 cm-1 corresponds to the –N=C=S iso-thyocyanates, 1658 cm^{-1} peak represents C=O stretching and bend –NH of amide linkages. 1396 cm^{-1} corresponds to the C-O and C-N stretching vibrational frequency and sharp band at 715 cm−1 is responsible for bending vibration of –CH2 group. A AuNPTSG showed a significant shift in the hydroxyl, carbonyl and amino group bands. This is evident that the hydroxyl and carbonyl groups are responsible in the reduction and further stabilization process.

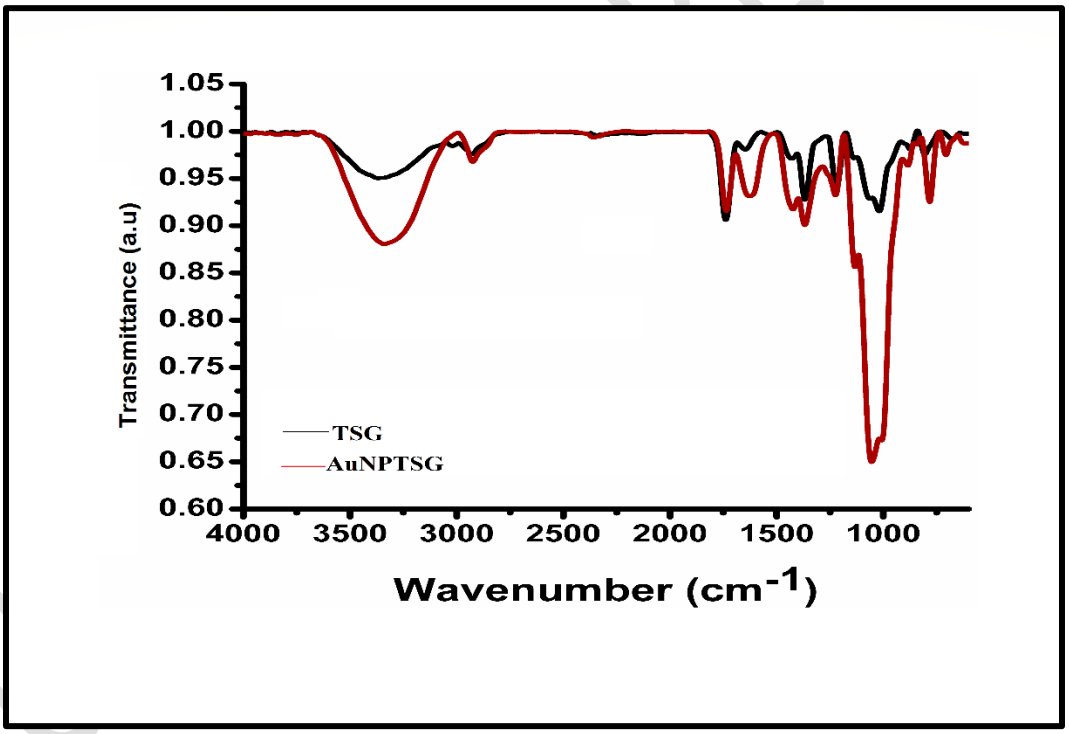

Figure 2. FT-IR Spectra of TSG and AuNPTSG.

XRD analysis of AuNPTSG

Figure. 3 shows the X-ray diffraction analysis obtained for AuNPTSG synthesized using NG, the four different diffraction peaks at two theta values are 37.19, 44.40, 64.21 and 78.57◦, corresponding Bragg reflections are (111), (200), (220) and (311). Four sets of lattice planes are detected this may indexed of face-centered cubic (fcc) structure of AuNPTSG. The XRD pattern is evidently showed that the AuNPTSG obtained from the reduction of $AuCl_3^{-3}$ by TSG, crystalline in nature and spherical shape. The broad Bragg's peaks indicating that AuNPTSG were nanoscale in dimensions.

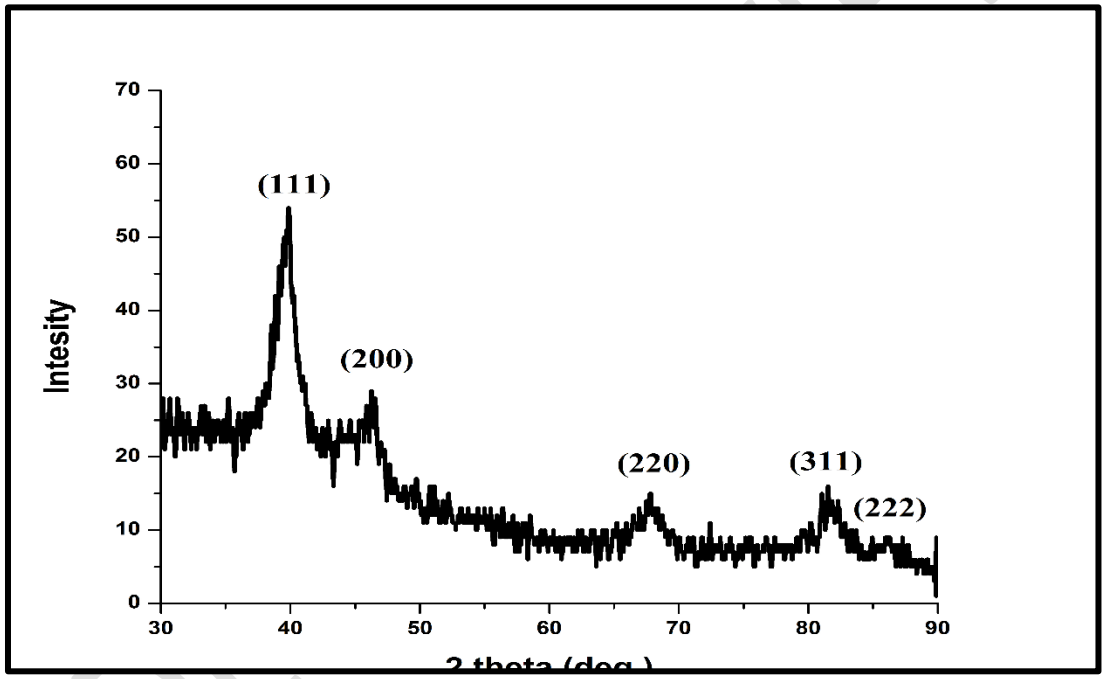

Figure 3. XRD pattern of the AuNPTSG

TEM analysis of AuNPTSG

Figure. 4 Demonstrated the possibility of AuNPTSG shape, size distribution, smooth surface morphology and a variable particle size. The spherical AuNPTSG were formed with diameter ranging from 2 to 7 nm and are of highly mono-dispersed in nature.

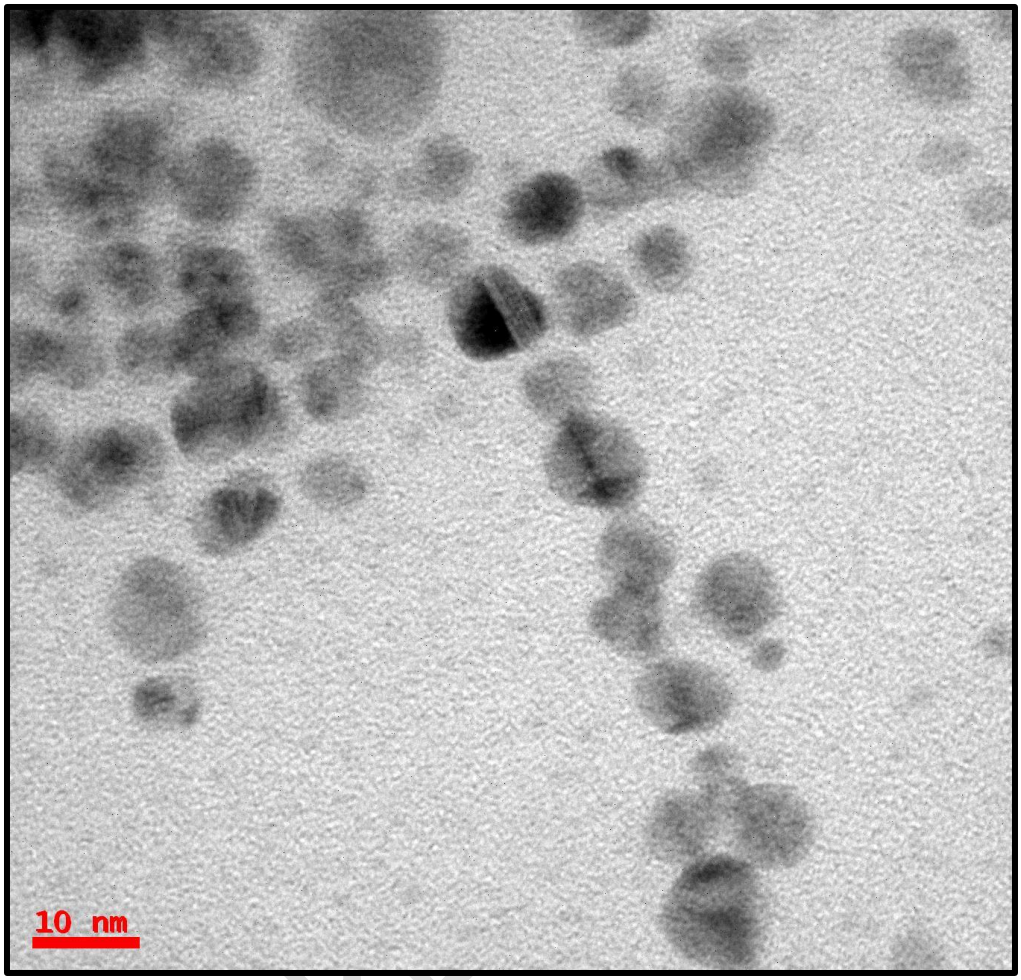

Figure. 4 TEM image of AuNPTSG in aqueous system using TSG as reducing and

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