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Nanoparticles of Gold and Silver

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Abstract: *Gold and silver nanoparticles have attracted great interest in many fields such as being used as biosensors, in tissue engineering, diagnostic devices, and chemo therapies etc. These nanoparticles proved to be the safest and much less toxic agents for the environment. Therefore are synthesized using different chemical and biological methods for specific applications.*

Keywords: *Evaporation-condensation; Spark discharging; Pyrolysis; Hyperthermia therapy; Dynamic light scattering.*

1. Introduction

Gold and silver nanoparticles possess large surface area and by altering its size, properties of gold nanoparticles can be modified to make it applicable for different uses [1].such as nanoshells, nano cages and nanorods are types of nanoparticles which differs in their size and structural layout to serves specific functions [2].

Characterization of Nanoparticles Could Be Using the Following Techniques

- Transmission and scanning electron microscopy
- Atomic force microscopy
- Dynamic light scattering
- X-ray photoelectron spectroscopy
- Powder X-ray diffractometry
- Fourier transform infrared spectroscopy
- UV–Vis spectroscopy [3,4,5]

2. Fabrication of Gold Nanoparticles

2.1. Chemical Approach

Gold nanoparticles were prepared by reacting hydrogen tetrachloroaurate with citric acid which act as a reducing and stabilizing agent to reduce gold ions into its respective nanoparticles appeared as reddish yellow in color in the solution confirming its synthesis [6].Gold nanoparticles could also be produced using sodium borohydrate as reducing agent[7].

2.2. Biological Approach

This method uses biological organisms such as microbes, fungi, plant and plant extract to fabricate nanoparticles of different morphology [8].For example Neem, Madicago sativa, onion, and Aloe vera etc are well known producers of gold nanoparticles [9].

3. Applications of Gold Nanoparticles

Applications of gold nanoparticles are as follows:

- **Electronics**

Gold nanoparticles are fabricated to be used as conductors, connectors and in designing electronic chips [10].

- **Hyperthermia Therapy**

Gold nanoshells and nanorods produces heat when excited therefore is used to eradicate targeted tumors [11].

- **Therapeutic Delivery**

The large surface area of gold nanoparticles permits their surface to be layered with hundreds of molecules (including therapeutics, targeting agents, and anti-fouling polymers) [12].

- **Sensors**

Gold nanoparticles were employed as colorimetric sensor to identify food suitability for consumption [13].Besides such nanoparticles were used in surface enhanced Raman spectroscopy, exploit gold nanoparticles as substrates to detect proteins, toxins etc [14].

- **Probes**

Light scattering property of gold nanoparticles are presently employed in medical imaging applications [15].Besides being used as probes for transmission electron microscopy [16].

- **Diagnostics**

Detection of biomarkers in the diagnosis of different diseases employs the use of gold based nanoparticles [17].

- **Catalytic Reactions**

Gold nanoparticles are used for selective oxidation for fuel cell applications [18].

4. Benefits of Gold Nanoparticles

- Easy to use in diagnostics
- It is less intrusive
- It is non-toxic and environmentally friendly [19]

5. Drawbacks of Gold Nanoparticles

- Optical signal is weak as compared to quantum dot
- Low biocompatibility, in-vivo kinetics and tumor targeting efficiency
- Prone to acute or chronic toxicity
- Reticuloendothelial system is sensitive to gold nanoparticles [20, 21].

6. Fabrication of Silver Nanoparticles

- **Physical Method**

silver nanoparticles are fabricated using different physical methods such as evaporation-condensation, spark discharging and pyrolysis [22].The benefit of this approach is the use of non- hazardous however low yield ,high energy consumption, solvent contamination, and lack of uniform distribution makes these method less popular to be used [23] .

- **Chemical Method**

These methods uses metal precursors, reducing agents, and stabilizing/capping agents to prepare silver nanoparticles [24].The major advantage of chemical methods is high yield, contrary to physical methods, which have low yield [25].

- **Biological Approach**

This method uses biological organisms such as bacteria, fungi, plant extract to produce nanoparticles of silver [26].

7. Applications of Silver Nanoparticles

They have been used in many applications such as

- **Antibacterial Agents**

Silver nanoparticle is a well-known antibacterial agent used in health industry, food storage, textile coating etc [27].

- **Optical Probes**

Silver nanoparticle is used as probes for Surface-enhanced Raman scattering [28].

- **Metal-enhanced Fluorescent**

Silver nanoparticles displayed higher extinction coefficients, sharper extinction bands and high field enhancement [29]

- **Medical Treatments**

Silver nanoparticle is employed as anticancer agent to treat different types of cancerous cells [30].

- **Sensors**

Protein encapsulated silver nanoparticles are used as peptide sensors to identify protein interaction efficacy [31].

8. CONCLUSION

Thus gold and silver metallic nanoparticles are now being employed in various disciplines because of their unique structural and functional capabilities.

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