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Mini Review

Copper Nanoparticles-Synthesis and Applications

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Abstract

Now a day's use of copper nanoparticles is quite popular due to their unique physical and chemical properties thus enabling their applications in different areas of engineering and technology. Due their unique catalytic and physiochemical properties, copper nanoparticles were employed in process like metal ion reduction, electrical and thermal conductivity etc. Cost effective fabrication of copper based nanoparticles is achieved by means of using biological organisms such as bacteria, yeast, and fungi etc as manufactories in contrast with physical /chemical methods that are expensive and make use of hazardous chemicals that poses environmental risks.

Keywords: Electron Affinity; Phase Transition; Microemulsion; Laser Ablation; Fluorescence Quenching

Introduction

Copper based nanoparticles are orbicular blackish-brownish metallic nanoparticles with size ranges from 30 to 70 nanometers with high surface area usually available in either pure, dispersed or carbon coated form [1,2]. Copper nanoparticles displayed elevated ultraviolet visible sensitivity with strong electrical and thermal conductivity [3]. Elevated surface area and quantum effects contributes to the broad range antimicrobial activity of copper nanoparticles [4]. Surface area of different sized copper based nanoparticles varies due to their form and respective magnitude [5]. Alteration in the surface area of Copper nanoparticles influences their electron affinity, energy levels, phase transition, magnetic properties, transitions temperature, melting point, polymer/ biological/organic molecules affinity, quantum effects and catalytic properties [6-9].

Physical /Chemical methods for the amalgamation of Copper based nanoparticles:

- Microemulsion: it is the mostly used technique employed for the synthesis of Copper Nanoparticles but it's quite expensive due to heavy consumption of surfactants and initial reactants [10].
- Aerosol technique, Laser ablation and Radiolysis: Use of costly equipment's and excessive energy uptake makes these methods less commercial [11].
- Microwave irradiation [12].
- Ascorbic acid addition by the formation of copper oxide to form its respective nanoparticles [13].
- Addition of strong reducing agents to copper ions micelles causes its disintegration into copper nanoparticles [14].

These methods are quite expensive and make use of hazardous chemicals that poses serious environmental issues therefore use of bio based methods were the suitable alternative option for their synthesis.

Biological methods for the amalgamation of Copper based nanoparticles:

Green synthesis of copper nanoparticles by means of biological organism is much safer and eco- friendly approach [15].

Plant based Nano-synthesis

Plants serves as the most cost effective and environmentally friendly Nano factories for the fabrication of copper based Nano

entities [16]. Due to their easy availability, various plants and their extracts have been used to synthesize copper nanoparticles of different morphologies. Such example includes extract of plant T. Arjuna [17], Mangolia [18] etc.

Microorganisms based Nano-synthesis

Cubic shaped copper nanoparticles have been synthesized using Pseudomonas Stutzeri bacteria [19]. Similarly, it is reported that Morganella bacteria produces polydispersed nanoparticles [20]. Besides, fungi such as Penicillium and Aspergillus species have been reported to synthesize copper nanoparticles with unique morphology [21].

Applications of Copper based nanoparticles:

- Copper nanoparticles have been used in the preparation of disinfectant for wastewater [22].
- Copper nanoparticles displayed high antibacterial activity against B. subtilis [23].
- These metallic nanoparticles offer appropriate catalytic potential [24] and dye reduction properties [25].Copper nanoparticles also known to produce fluorescence, causing dye accretion/de accretion thus making them suitable for biosensing and biolabeling [26,27].
- Copper nanoparticles coated drugs are extensively used to destabilize cancerous and tumorous cells [28].
- etc.

Conclusion

Thus Copper nanoparticles are among the most widely used metallic nanoparticles with unique physiochemical properties. Numerous chemical and biological methods are available for the fabrication of these nanoparticles with commercial applications in different areas such as in catalytic reduction, electrical and thermal conductivity, nanomedicine, antimicrobial agents etc.

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