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Green Synthesis of Silver and Silver-Gold Alloy Nanoparticle Using Cyanobacteria as Bioreagent

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Abstract : Cyanobacteria, commonly known as blue green algae were found to be an effective bioreagent for nanoparticle synthesis. Nowadays silver nanoparticles (AgNPs) are very popular due to their antimicrobial and anti-proliferative activity. To exploit these characters in different biotechnological fields, it is very essential to synthesize more stable, non-toxic nano-silver. For this reason silver-gold alloy (Ag-AuNPs) nanoparticles are of great interest as they are more stable, harder and more effective than single metal nanoparticles. In the present communication we described a simple technique for rapid synthesis of biocompatible AgNP and Ag-AuNP employing cyanobacteria, Leptolyngbya and Lyngbya respectively. For synthesis of AgNP the biomass of Leptolyngbya valderiana (200 mg Fresh weight) was exposed to 9 mM AgNO3 solution (pH 4). For synthesis of Ag-AuNP Lyngbya majuscula (200 mg Fresh weight) was exposed to equimolar solution of hydrogen tetra-auro chlorate and silver nitrate (1mM, pH 4). After 72 hrs of exposure thallus of Leptolyngyba turned brown in color and filaments of Lyngbya turned pink in color that indicated synthesis of nanoparticles. The produced particles were extracted from the cyanobacterial biomass using nano-capping agent, sodium citrate. Firstly, extracted brown and pink suspensions were taken for Energy Dispersive X-ray (EDAX) analysis to confirm the presence of silver in brown suspension and presence of both gold and silver in pink suspension. Extracted nanoparticles showed a distinct single plasmon band (AgNP at 411 nm; Ag-Au NP at 481 nm) in Uv-vis spectroscopy. It was revealed from Transmission electron microscopy (TEM) that all the synthesized particles were spherical in nature with a size range of ~2-25 nm. In X-ray powder diffraction (XRD) analysis four intense peaks appeared at 38.2°, 44.5°, 64.8°and 77.8° which confirmed the crystallographic nature of synthesized particles. Presence of different functional groups viz. N-H, C=C, C–O, C=O on the surface of nanoparticles were recorded by Fourier transform infrared spectroscopy (FTIR). Scanning Electron microscopy (SEM) images showed the surface topography of metal treated filaments of cyanobacteria. The stability of the particles was observed by Zeta potential study. Antibiotic property of synthesized particles was tested by Agar well diffusion method against gram negative bacteria Pseudomonas aeruginosa. Overall, this green-technique requires low energy, less manufacturing cost and produces rapidly eco-friendly metal nanoparticles.

Keywords : cyanobacteria, silver nanoparticles, silver-gold alloy nanoparticles, spectroscopy
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