Fungi as Builders For Nanomaterials

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Article Summary: *"An important challenge in nanotechnology is to tailor optical, electric and electronic properties of nanoparticles by controlling the size and shape. Utilization of microbe for synthesis of nanoparticles with different chemical composition, size/shapes and controlled monodispersity to develop environmental friendly nanoparticle.."*

Nanotechnology is the creation of useful materials, devices and systems through the manipulation of such miniscule matter. When the size of the material is reduced to less than 100 nanometers, the realm of quantum physics takes over and materials begin to demonstrate entirely new properties. At this extremely small size, the electrons of the atoms will stay on the surface of the atom instead of orbiting inside it and show unusual physicochemical and optoelectronic properties.

An important challenge in nanotechnology is to tailor optical, electric and electronic properties of nanoparticles by controlling the size and shape. Currently, there is a growing need to develop environmentally benign nanoparticle synthesis processes that do not use toxic chemicals in the synthesis protocol. Utilization of microbe for intracellular/extracellular synthesis of nanoparticles with different chemical composition, size/shapes and controlled monodispersity can be a novel, economically viable and eco-friendly strategy that can reduce toxic chemicals in the conventional protocol. Many microbes produce inorganic substances of interest e.g. silica from diatoms while other microbes ***formulate nanoscale magnetic particles out of iron oxides. Some microbes consume metals and then excrete them in precise configurations.***

A number of different genera of fungi have been investigated and are extremely good candidates ***in the synthesis of metal and metal sulphide nanoparticles.*** Verticillium sp. and Fusarium oxysporum, when exposed to aqueous gold and silver ions can reduce the metal ions fairly rapidly. The Verticillium can be induced to fabricate silver nanoparticles within its cells when it's placed in a silver nitrate solution. Extremophilic actinomycete, Thermomonospora sp. is able to produce extracellular gold nanocrystals.

Fungi can be used as builders for nanomaterials as nanotechnology can work with nature to produce fascinating and potentially useful structures. Fungus filaments can also act as living template. As a filament of fungus grows, gold nanoparticles attach to its surface creating additional layers of particles of different sizes or materials.

The gold-plating of their hyphae fungi does not impede the growth of the fungi so long as they continue to receive suitable nutrients. By changing the medium and using gold nanoparticles of a different size, the resulting tubes can be grown with different coatings from one section to the next. This fascilitate the use of microorganisms as living templates or biological slaves to generate macroscopic architectures with strict control over the microscopic and nanoscopic dimensions of the resulting materials. Hence this approach can

be used to build high surface area materials with catalytic properties that derive from the choice and spatial distribution of the nanoparticle building blocks arranged on the fungal living templates. Studies demonstrated that silver ions may be reduced extracellularly using Fusarium oxysporum to generate stable gold or silver nanoparticles in water. Aspergillus niger in the presence of 13-nm-wide gold particles that aggregated on the fibrous hyphae. ***Other fungus-based nanostructures might serve as designer optical, electronic, and magnetic materials.***

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