

World of Nanobionics

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Abstract

Nanobionics involves the manipulation of nanomaterials to be employed in several applications in areas like medical, textile, plant biotechnology, microbial technology etc. by enhancing the performance of their existing functions such as higher productivity, variations in molecular adhesion, increased photosynthesis etc.

Keywords: Plants nanobionics; Nanostructures; Nanoceria; Single-walled carbon nanotube; Nanosheets

Introduction

The term bionics is the study of biological system at nanoscale involving the manipulation of nanomaterial's, to be used in numerous applications [1]. Nanobionics is an alternative approach of nanobiotechnology which alters the properties of materials and these altered properties get translated in various applications during fabrication at nanoscale [2]. Nanobionics offers numerous benefits in various areas by changing properties of materials such as increased surface area, faster reaction rate and switching speeds, higher productivity, variations in protein adhesion/cellular interactions, control of cellular/molecular events etc. [3-7].

Plants nanobionics

The idea of nanobionics to use in plants was given by Michael [8]. Later nanobionics resulted in countless advancements in the field of plant biotechnology such as improved biochemical sensing and solar energy harnessing in plants by introducing nanomaterial in their cells [9], augmented seed germination, plant growth and development using genetically modified carbon nanotubes etc. [10]. Thus plants nanobionics has an excessive potential to develop novel tools for the integration of nanoparticles into plants to increase the existing functions [11].

Examples

Increases photosynthesis: With the help of nanobionics technology when non-biological nanostructures are amalgamated with plant organelles such as single walled carbon nanotube when introduced into chloroplast elevates the rate of photosynthesis three times and a higher electron transport was achieved [12,13].

Decreases sensitive oxygen species generation: Single-walled carbon nanotube-nanoceria complex (cerium oxide) when introduced into the chloroplasts, it sequesters the highly reactive molecules to avert the generation of sensitive oxygen species that damages the chloroplast [14,15].

Biochemical sensing and harvesting light in photosynthesis: Scientists all around the globe have continuously tried to develop ways to improve the isolated chloroplast that can be used for solar cells [16]. For example, spinach incorporated with TiO_2 speeds up the oxygen evolving rate of photosystem II and electron transport [17]. Similarly, Gold nanoparticles were discovered to upsurge the absorption of photons in the light harvesting molecular complexes thus improves photosynthesis rate by enhancing the rate of electron transport, photophosphorylation as well as augmented oxygen rate [16].

Detectors for various chemical present in the environment:

Plants bonded with nanoparticles act as chemical detectors to identify their presence in soils, water and air [18].

Glowing plants: Formation of specific nanoparticles into watercress plant leaves resulted in emission of light like a lamp [19].

Medical nanobionics

Medical nanobionics have numerous applications in the medical field such as in artificial muscles by using electrochemical actuators which stores electric energy and convert it into mechanical energy by using carbon nanotubes, metal oxides, N-doping and nanosheets [20]. In addition, application in nerve stimulation, eye and ear treatment etc. [21,22].

Textile nanobionics

Using nanobionics in clothing is an efficient method to get rid of diseases caused by free radicals [23]. For example, cloths designed to emit infra-red radiations that decreases the concentration of free radical [24]. Another example is the manufacturing of mineral oxide based polyurethane textile which helps the body to absorb thermal emission and transform it into far infrared radiations [25].

Fungal nanobionics

Fungal nanobionics offers significant applications for the development of novel medical, industrial, agricultural products [26,27].

Upcoming prospects of nanobionics

1. Nanobionics has huge potential to produce novel and useful properties for the improvement of solar energy by organisms and also by photosynthetic organelles [28].
2. Nanobionics applications in plants leads to improved grain yield, seed germination etc. [29]
3. Nanomaterials used for the transportation/delivery of DNA/drugs into the plant cell [30].

Conclusion

Nanobionics and its applications is a revolutionary science which is enhancing and improving our lives the future we see in science fiction movies, seems to be a reality now with the help of nanobionics.

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