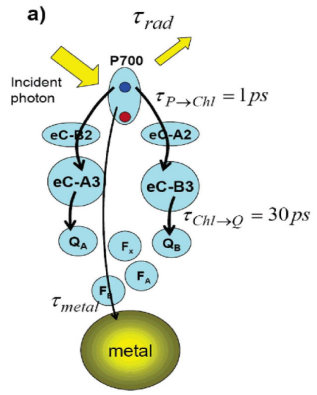
A Hybrid System to Enhance the Rate of Biological Fuel Production Under Solar Illumination

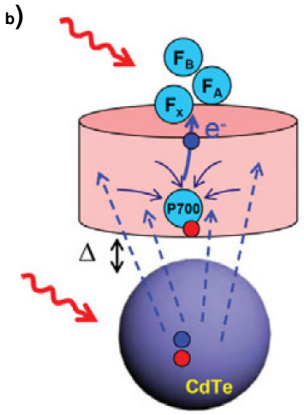
TECHNOLOGY OVERVIEW

The technology is a device that facilitates the production of biofuels in the form of high energy bio-molecules with enhanced characteristics. The device is a hybrid system that is composed of a natural photosystem held together by a membrane and crystalline nanoparticles. The system is capable of producing biological fuels when irradiated by solar or any other kind of illumination. The presence of the metallic or semiconductor nanoparticles helps to enhance the effectiveness of the photosynthetic process. This is achieved by significantly increasing the rate of light absorption by the chlorophyll pigments due to plasmon enhancement of metal nanoparticles or due to Förster energy transfer from highly-absorbing semiconductor nanoparticles. The process facilitates the utilization of photosynthetic molecules in an active medium due to their high quantum yield and energy conversion efficiency. Multifold increment in the chlorophyll fluorescence for complexes was observed when they were placed near metallic nanoparticles. The adjoining diagrams are a schematic representation of the plasmon-enhancement and Förster energy transfer processes.



POTENTIAL FIELDS OF USE

The most important application of the technology would be in the fabrication of sensitive sensor devices and efficient photocells. The technology can facilitate the application of plasmonic nanostructures to control the optical response of complex biomolecules. It would also help in improving the design and the functioning of artificial light-harvesting systems. Related areas such as optical spectroscopy, cell imaging, information processing, nanophotonics and biosensors could greatly benefit from the technology. The worldwide requirement for biofuels is expected to grow at an aggressive rate of more than 12.3% from 2007 through 2013. Also, the current statistics show that the global photocell market stands at a staggering $7.3 billion.



BENEFIT ANALYSIS

The new technology is a novel procedure and has several advantages:

- Enhanced performance of devices based on photocurrents in photosynthetic complexes.
- Increased yield of chemical energy that can be produced using a smaller number of reaction centers.
- Minimized energy loses from the system due to fast separation of the electron-hole pair.
- Increased absorption in the range of wavelength from the solar spectrum by the hybrid system as compared to natural photosynthetic systems.

STAGE OF DEVELOPMENT

A hybrid system has been modeled which is composed of photosynthetic molecules along with metal nanoparticles and nanoshells. Plasmon resonances were shown to greatly enhance the photochemical production in the system. First experiments performed with antenna chlorophylls are very successful and show strong enhancement of generation of electron-hole pairs inside photoactive chlorophylls.

FUTURE DEVELOPMENT

The increased photochemical production comes at the cost of a reduced quantum yield. Future efforts could be concentrated on improving the quantum yield ratio of the process. The usage of larger nanocrystals could increase the electron production in the system.

LICENSING OPPORTUNITIES

The patent application for this technology has been filed. Licensing opportunities are available.

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