UNIVERSITY OF MINNESOTA
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Improving photovoltaic cell efficiency by employing highly stable, earth-abundant nanoparticle system

A novel nanomaterial for applications involving photon upconversion.

Applications

- Photovoltaics, near infrared (NIR) photodetection, displays, photodynamic therapy, medical imaging, thermal management, photochemistry, etc.

Key Benefits & Differentiators

- Material highly stable in solution and in air
- Material can be embedded in glass or films
- One of the lowest threshold upconversion materials
- Upconversion possible under continuous wave irradiation

Photon upconversion with low-threshold wave laser illumination

Photon upconversion is a process in which low energy photons are converted into higher energy photons. Potential applications include solar energy harvesting as well as other applications such as photodynamic therapy, thermal management, and deep-tissue imaging. Most state-of-the-art photon conversion materials (such as lanthanides and non-linear crystals) require high intensity, coherent light and the alternatives (such as triplet-triplet-annihilation) have limited bandwidth of operation and are typically unable to make use of near-infrared (NIR) spectrum. In addition, materials that undergo upconversion under low intensity continuous wave excitation are extremely rare.

Researchers at the University of Minnesota have developed a plasmonic nanomaterial that shows strong upconversion with low-threshold continuous wave laser illumination. This material can convert low energy photons (in the near infrared region) to high energy photons (in the visible region) under non-pulsed illumination. This material ranks among the lowest threshold upconversion materials currently available and is non-toxic, highly stable in solution, and could easily be processed to make upconverting glasses or films.

Upconversion in solar panels and therapeutics

In current photovoltaics, about two-thirds of the incident spectrum is lost; low energy photons do not have enough energy to move electrons to the conduction band. Employing the process of upconversion, wherein two or more low energy photons are converted to one higher energy photon, can reduce these spectrum losses and increase the efficiency of solar panels. This material could be applied as coatings on top of conventional solar cells, thus increasing their efficiency at very low cost. In addition, as this material is non-toxic and small enough to be easily endocytosed, it could be used for phototherapeutic or deep tissue imaging applications using excitation in the near-infrared window.

Technology ID

2020-126

Category

Engineering & Physical Sciences/Materials
Engineering & Physical Sciences/MRI & Spectroscopy
Engineering & Physical Sciences/Nanotechnology
Engineering & Physical Sciences/Photonics
Engineering & Physical Sciences/Semiconductor
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Phase of Development

TRL: 2-3

Basic functional characterization.

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Publications

- **Plasmon-enhanced chemical conversion using copper selenide nanoparticles.** Nano letters 19.4 (2019): 2384-2388.

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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