上轉換及表面等離子體共振納米材料
Upconversion and Plasmonic Nanomaterials

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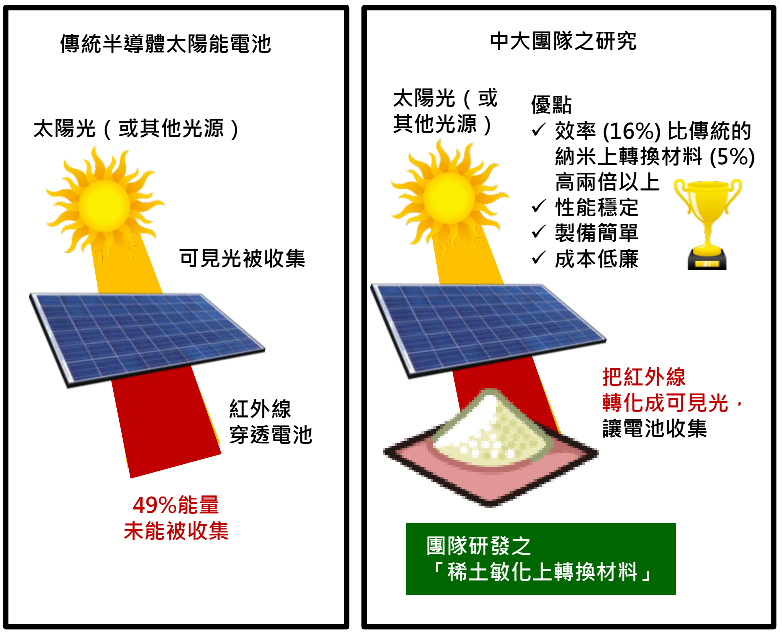
針對問題 Problem to be Solved

太陽光中，49%的能量來自紅外光波段，但傳統半導體太陽能電池由於本身的禁帶寬度所限，絕大部分紅外光是無法被吸收並轉化為電能。在不改變太陽能電池材料本身的前提下，要有效利用紅外光是一個很艱鉅的挑戰。

49% of sunlight energy falls in infrared region. Due to the limitation of bandgap in semiconductor solar cells, majority of infrared energy was not absorbed and converted into electricity. Given no change to the materials of solar cells, efficient use of infrared energy is a challenging task.



太陽光中，49% 的能量來自紅外光波段，可是傳統太陽能電池來未能收集紅外光能量。研究團隊研發的新型稀土敏化轉換料，能夠把紅外光直接轉化為可見光，讓太陽能電池收集。它的能量轉換效率達 16%，比傳統的納米上轉換材料 (5%) 高兩倍以上。

特點及優勢 Uniqueness and Competitive Advantages

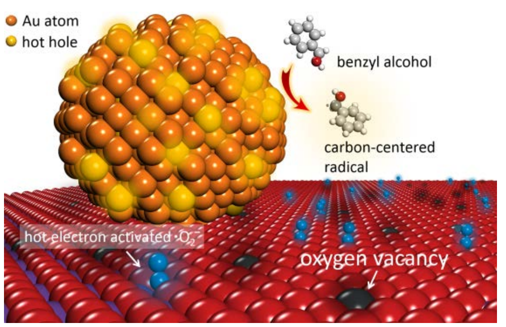
團隊研發了一種新型的稀土敏化轉換材料，能夠把紅外光直接轉化為可見光，能量轉換效率達到16%，相比傳統的納米上轉換材料效率提升一倍以上。這種材料性能穩定，製備簡單，成本低廉，並且成功將聚焦太陽光中的紅外光轉變成可見光。團隊也設計出了將太陽能電池和新材料相結合的模型。這項新科技還有很多潛在的商業應用價值，例如照明系統和顯示器等等。這項成果已發表於*《自然》*雜誌旗下子刊*《自然通訊》*上。

The research team invented an innovative lanthanide-sensitized oxide, reaching a maximal power upconversion efficiency of 16% for infrared light, which is at least double the efficiency of traditional nano-upconversion materials. This material is stable, with simple fabrication and low cost, and able to successfully convert infrared light into visible light. The team also designed solar cell models of this new material. The technology also has the commercialization potential of in lighting and computer monitors. This work has been published in *Nature Communications* in 2014.

在紅外光照射下，團隊研發的新型稀土敏化轉換材料能發出強烈的可見光。
Under the excitation of a near-infrared, the lanthanide-sensitized oxide powder developed by the team emitted strong visible light to the eye.

應用 Applications

應用於太陽能電池時，能把低於半導體禁帶寬度的光能轉化為高能量的光子。
Assist solar cells to convert subsemiconductor band-gap light energy into solar cell absorbable high energy photons.



等離激元產生的電荷載流子。激發局域表面等離激元產生熱電子和熱空穴，它們的協同作用驅動化學反應。
Plasmonically Generated Charge Carriers. The excitation of localized surface plasmon generates hot electrons and hot holes. The hot charge carriers interact synergistically to drive chemical transformations.

可授權專利
Available Patent

Converting infrared light into visible light using lanthanide-sensitized oxides
(Patent: US 14/279,128)

Advantages

- Conversion efficiency (infrared to visible light): >4% (max 0.1% for existing materials)

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