

■ Research Highlights

Innovative carbon nanotube photocatalytic materials for efficient solar energy conversion and hydrogen production

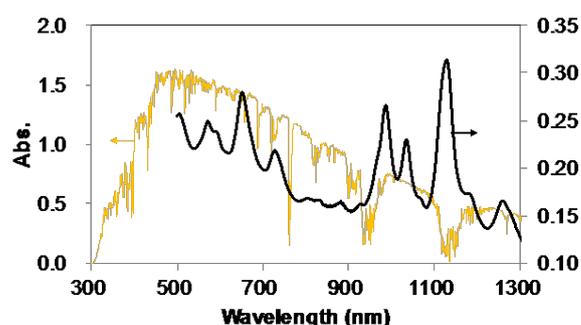
The unique properties of semiconducting single-walled carbon nanotubes (s-SWCNTs) offer significant advantages over organic molecules, semiconducting polymers, and solid-state semiconductors for wide ranging applications. In particular, s-SWCNT are potentially highly effective active absorption layers in thin-film solar cells because the optical absorption bands—that depend on the chiral indices, (n,m)—of s-SWCNTs exhibit excellent overlap with the useful solar spectrum range of the Sun’s radiation.

However, in other applications of carbon nanotubes, there have not been any reports on the use of s-SWCNTs as components of photocatalysts for splitting water into hydrogen (photocatalytic H₂) although photocatalytic-based water splitting is expected to be a key technology for solar energy conversion and sustainable production of hydrogen.

Now, Yutaka Takaguchi and colleagues at Okayama University, Yamaguchi University, and Tokyo University of Science report on the observation of photocatalytic H₂ evolution from water triggered by photoexcitation of s-SWCNTs.

The researchers fabricated a structure consisting of a s-SWCNT/C₆₀ coaxial heterojunction by a self-organization technique using fullerodendron to make s-SWCNT act as a photocatalyst. This heterojunction was used to induce the highly efficient H₂ evolution reaction from water, where the (8, 3) SWCNT/fullerodendron coaxial photocatalyst shows H₂-evolving activity (QY = 0.015) upon 680-nm illumination, which is E₂₂ absorption of (8, 3) SWCNT.

Due to strong absorption coefficients and ease of modifying s-SWCNTs, the CNT-photocatalyst could be a powerful candidate as a material for solar energy conversion and H₂ production without CO₂ emission.



Absorption spectrum of s-SWCNTs (black line) overlaid with solar spectrum (yellow line).

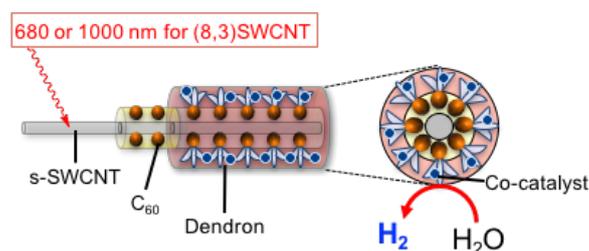


Illustration of SWCNT photocatalysts consisting of the s-SWCNT/C₆₀ coaxial heterojunction.

Reference

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