**Near-Infrared Light Photocatalysis over Upconverting Carbon Nitride Nanotubes**

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Solar-to-chemical energy conversion via photocatalysis has attracted tremendous attention as a potential solution to the worldwide energy shortage and environmental issues. Among various photocatlaysts, metal-free polymeric graphitic carbon nitride (g-C3N4) has attracted tremendous attention due to its low-cost and visible-light absorption. Our recent results demonstrate that C3N4 nanotubes (C3N4 NTs) exhibit higher activities than bulk C3N4 and C3N4 nanosheets. It is highly desirable to extend the absorption of C3N4 NTs into the near infrared region in order to maximize light harvesting. A promising way is to couple C3N4 NTs with lanthanide-doped upconversion nanoparticles (UCNPs) to construct sensitizer/ C3N4 NTs heterojunction as UCNPs are capable of converting near infrared (NIR) excitation to visible and even UV emissions. NaYF4 crystals have been regarded as the most efficient host material for upconversion matrixes and higher UC efficiency can be expected in rare earth ions-doped NaYF4. In the present work, we extend light absorption to NIR by anchoring NaYF4:Yb,Tm (NYF) NPs along nitrogen deficient C3N4 NTs. This nanostructure achieves high photocatalytic performance in hydrogen production and nitrogen fixation under NIR light irradiation. This enhanced photocatalytic activity is attributed to the synergistic effect, stronger interaction, higher emission intensity, and faster charge transfer between the two nanocomposites. This work demonstrates a versatile approach to develop a greener manufacturing process by using low-cost and NIR light-responsive photocatalysts.