Electroless plating of NiP_2 on GO surface for enhanced photocatalytic water splitting

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Abstract

In this investigation, we synthesized a layered graphene oxide @ nickel phosphide (NiP_2@GO) nanocomposites using electroless plating method. Nanocomposite had particle-size of 24nm with the bandgap energy of 2.39 eV and 14 number of layers. The photocatalytic water splitting activity of the nanocomposites were determined in a aqueous hole scavenger electrolyte (20% CH_3OH) solution under a 300W Xe light source irradiation. As-synthesized nanocomposites (NiP_2@GO) exhibited the tenfold increase in photocatalytic H_2 production rate of 408.947 $\mu molg^{-1}h^{-1}$ (apparent quantum efficiency =1.64% at 420nm) over the same for pristine GO sample 40.894 $\mu molg^{-1}h^{-1}$. The intensification photocatalytic activity is attributed to the formation of a p–n junction between rGO and NiP_2 that facilitate the charge transfer and suppressing recombination. The NiP_2 incorporation to GO not only enhances its light harvesting power but also ensure the smooth charge transfer throughout the GO network. Advanced analytical techniques (XRD pattern, UV-Vis spectra, FE-SEM, EDX, steady state PLE spectra, Raman, ESR, XPS, SPV, EIS, etc.) was used to revealed the profound insights into the photocatalytic electron transfer mechanism of the water splitting process wherein the cocatalyst NiP2 accelerates the separation of photo e^-- h^+ pairs, enabling efficient relay of photoelectron to reduce H_2O for hydrogen production.

Keywords: Electroless plating, NiP2, graphene oxide, photocatalysis, water splitting, H_2 generation.

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