Well dispersed cocatalytic Ni and NiO nanoparticles loaded on graphene oxide sheets enhance hydrogen production from photocatalytic water splitting

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Cocatalytic ultrafine Ni and NiO nanoparticles (~ 4 nm diameter) were uniformly loaded on graphene oxide (GO) sheets. Water splitting activity from aqueous methanol solution under UV-Visible light illumination was enhanced, approximately 4-fold for NiO/GO and 7-fold for Ni/GO, compared to bare GO. The highest activity (shown by Ni/GO) is attributed to minimal electron-hole recombination resulting from the easy transfer of photogenerated electrons from the GO photocatalyst to the Ni cocatalyst. The relatively lower activity of NiO/GO may be due to the less efficient electron trapping ability of the NiO surface. A mechanism for high energy density hydrogen gas evolution is proposed. This work revealed that a cocatalyst loaded on high surface area GO sheets can significantly enhance the evolution of hydrogen from direct water splitting. We believe that this study offers a route to green energy harvesting using readily available low cost materials in combination with simple, versatile and scalable techniques. It also encourages the utilization of new graphene based materials and its nanocomposites in a wide variety of applications in areas such as fuel cells, lithium ion batteries and sensors.

Key words: cocatalyst loading, graphene oxide sheet, water splitting, hydrogen production