

Photocatalytic processes for energy storage

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Abstract

Solar energy is intermittent and fluctuating, imposing the use of energy storage to accomplish continuous exploitation. Two fundamental uphill reactions are considered: solar conversion of CO₂ to solar fuels and H₂ production by photoreforming of carbohydrates, i.e. water splitting assisted by organic molecules acting as hole scavengers (HS).

The screening of heterogeneous photocatalysts has been carried out for both reactions considering surface decoration of TiO₂ P25, in detail:

- a. 0,1% mol noble metal loaded catalyst (0,1% mol Me/P25).
- b. 1,0% wt Au_xPt_y/P25.
- c. CuO/P25 catalysts with various co-catalysts loading.
- d. 1,0% wt CuO based P25 catalysts co-loaded with metal nanoparticles (Pt and Au).

Photoreforming for H₂ production has been carried out with model carbohydrate solutions and on simulated process liquors from pulp industry. The highest H₂ productivity and glucose conversion were obtained with 0.1% mol Pt/P25, reaching a value of 4.2 mol kg_{cat}⁻¹·h⁻¹ and 13 % respectively. 25 to 50% lower values were obtained when reforming more complex molecules in mixture, such as liquors from pulp industry.

Photoreduction of CO₂ has been carried out at high pressure and high temperature achieving a productivity of formic acid overperforming most literature results, i.e. ca. 60 mol kg_{cat}⁻¹·h⁻¹.

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