

Clean Hydrogen Production From Photocatalytic Degradation of Plastic Wastes

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Hydrogen (H₂) is identified as a clean energy source and can be produced from fossil fuels and biomass gasification, and water splitting using electrolysis. However, the current H₂ production processes are expensive and intensive. Photo-reforming is an attractive H₂ production technology that can use solar energy and plastic wastes as feedstock. Globally, it is estimated 448 million metric tons of plastics are generated annually and 60% become environmental pollutants. The accumulation of recalcitrant plastics has caused significant concerns about their health risks and ecological impacts. Conversion of high-volume plastic wastes to H₂ is critical to protect public health and ecological systems while generating a clean energy source for a net-zero-carbon economy. This project developed an innovative technology by converting abundant plastic wastes to H₂ using a low-cost, solar photo-reforming process. High-performance photocatalysts were synthesized by doping Au nanoparticles onto TiO₂ to improve light utilization and catalytic activity by reducing the energy bandgap and recombination rate of generated radicals. Laboratory experiments demonstrated photo-reforming was effective for H₂ production by degrading a variety of common plastics, such as polyethylene (PE), high- and low-density polyethylene (HDPE and LDPE), polyethylene terephthalate (PET), and polystyrene (PS). The low- and medium-grade plastics (LDPE, PE, and PS) produced the highest amount of H₂. The recyclable high-grade plastics (PET and HDPE) generated a lower amount of H₂ due to their stronger chemical bonds and low H ratio. This project provides a low-cost clean H₂ production technology while improving environmental sustainability by reducing greenhouse gas emissions and remediating plastic contamination.

Awards Won:

Third Award of \$1,000