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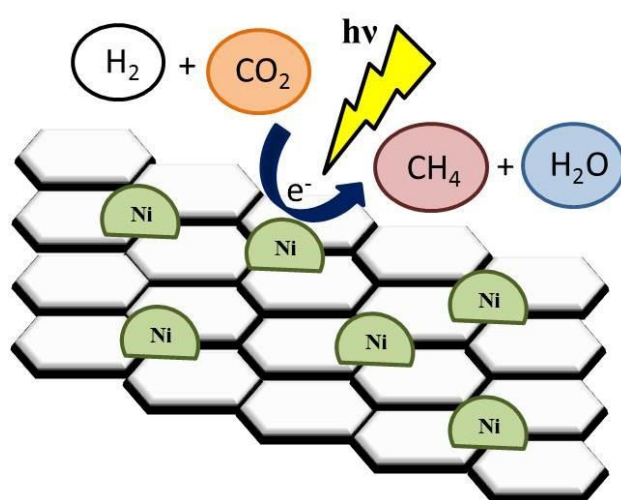
Graphene supported NiO/Ni nanoparticles as efficient photocatalyst for gas phase CO₂ reduction with hydrogen

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Graphical abstract



Highlights

- Ni nanoparticles supported on graphene form spontaneously a thin layer of NiO
- NiO/Ni on graphene promotes photoassisted CO₂ methanation at 642 μmol/g·h at 200 °C
- The process can be carried out under continuous flow at rates 244.8 μL · h⁻¹
- The presence of electron donors increases the rate of the photoassisted methanation
- Nitrobenzene quenches methanation, supporting charge separation

Abstract

The photocatalytic activity of NiO/Ni nanoparticles (NPs) supported on defective graphene (NiO/Ni-G) has been tested for the photoassisted CO₂ reduction with H₂. NiO/Ni-G was prepared by H₂ reduction of NiCl₂ adsorbed on few-layers defective G and storage under air. An optimal Ni loading of 23 wt% was found, reaching the maximum specific CH₄ formation rate (642 μmol CH₄ · g_{Ni}⁻¹ · h⁻¹ at 200 °C) and quantum yield of 1.98 %. Under the same conditions Ni NPs supported on silica-alumina or NiO NPs exhibit notably lower specific CH₄ production rates than NiO/Ni-G. It was found that H₂O formed in the reaction has a detrimental influence on the photocatalytic activity and evidence supports that H₂O

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