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Structure-reactivity relationships of Ni-NiO core-shell co-catalysts on Ta_2O_5 for solar hydrogen production

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Highlights

- A series of Ni-NiO core-shell co-catalysts were prepared on Ta_2O_5.
- Different morphologies resulted in large changes in photocatalytic activity.
- Increase in H_2 production was related to increase in thickness of NiO shell.
- NiO nanoblocks and hollow NiO shells were observed as the deactivated structures.
- Deactivation was due to loss of metallic Ni from the core structure.

Abstract

Ni-NiO core-shell co-catalyst structures on Ta_2O_5 have been investigated for solar H_2 production. Core-shell co-catalysts with different morphologies resulted in large changes in photocatalytic activity. Increased H_2 production was found to be related to an increase in the thickness of NiO shell due to suppression of the back reaction. Atomic level transmission electron microscopy showed that the core-shell co-catalyst structures deactivated primarily due to a loss of metallic Ni from the core structure. During deactivation, the catalyst transformed either to structures consisting of NiO nanoblocks or hollow NiO shells. The phase transformations occurring during deactivation were associated with Ni diffusion processes that are driven by light