Facet-dependent Carrier Dynamics of Cu_2O in Regulating the Photocatalytic H_2 Generation

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The emergence of well-defined architectured photocatalysts has led to the realization of cuprous oxide (Cu_2O) as a promising photocatalyst due to its earth abundancy, ease in synthesis and band potential suitability for photoredox reactions.[1] In this regard, Cu_2O that can be activated by visible light is considered as a good candidate due to its appropriate conduction and valance band potentials. However, photocorrosion and rapid charge recombination are known to be the largest drawbacks of Cu_2O.[2] Our previous work systematically studied the photostability pathway of Cu_2O to mitigate the photocorrosion problems and have suggested that self-photooxidation of Cu_2O is the dominant photocorrosion pathway in a photocatalytic suspension system. Thus, the presence of hole scavenger was demonstrated to be vital in extracting holes from Cu_2O and suppressing its oxidation into CuO.[3] Meanwhile, this study investigated the facet-dependent properties to further understand the charge transfer and separation within Cu_2O. With a stable Cu_2O photocatalyst, facet-dependent properties were revealed to play an important role in tuning the photocatalytic performance. Apart from the common facet-dependent properties (i.e. surface adsorption ability and surface electronic structures), the differences in surface defect density and charge carrier dynamics of each Cu_2O also alter the photocatalytic performance of Cu_2O. With proper morphological control of copper-based photocatalysts, photocatalytic performances can be enhanced. Apart from the understanding the photostability issues via systematic photocorrosion study, the effects of its facet-dependent properties towards photoreactivity were addressed.

References

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