二酸化炭素および窒素を反応対象とした光触媒の開発

Development of photocatalysts toward chemical transformation of CO_2 and N_2

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CO_2 reduction into chemical fuels as well as green H_2 production via water splitting is an attractive artificial photosynthetic reaction for realizing sustainable society. CO_2 reduction requires high electron potential and multiple electrons, and hence the reaction is more difficult than water splitting. In the present study, visible-light-responsive photocatalysts were developed and applied to CO_2 reduction using water as an electron donor.

Doping of some elements into metal oxides are useful technique to sensitize the metal oxides to visible light. In line with this strategy, we have developed original doped photocatalysts for water splitting under visible light irradiation. The doped photocatalysts split water into H_2 and O_2 when suitable cocatalysts were loaded. Interestingly, the water splitting activity was dramatically enhanced by surface treatment with a molten salt flux. Increasing in the crystallinity and exposure of specific crystal facets by the flux treatment will be the reason for the enhanced water splitting activity.

The improved photocatalysts were applied to CO_2 reduction. In the CO_2 reduction, cocatalysts plays important role due to the requirement of high electron potential. In the present study, we have found some effective metals that work as active sites for CO_2 reduction. Importantly, O_2 was obtained as the sole oxidation product during the CO_2 reduction, indicating that water was used as electron source. Coloading of other elements further improved the activities.

Thus, we have successfully developed original photocatalysts for water splitting and CO_2 reduction.