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Development of Photocatalysts for Water Splitting through Modifying their Surface Structure

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Photocatalytic water splitting allows producing green hydrogen without the need to be connected to the electric grid. Photocatalysts absorb light and generate electron hole pairs. Provided that the energy levels of the valence band and conduction band are positioned below and above the energy levels required for the oxygen and hydrogen evolution reaction, respectively, the absorbed light energy can be used to generate H₂ and O₂.¹ Photocatalysts consist typically of three components: the light absorbing material, the co-catalysts for facilitating the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER).

This presentation focuses on two aspects of developing photocatalysts. The first aspect is the use of atomic precise nanoclusters as HER and OER co-catalysts.² These nanoclusters can be tailored for specific reactions. The second aspect is the application overlayers. These overlayers both protect the nanoclusters from agglomeration and protect the water splitting process from the backreaction to occur. The backreaction converts the generated H₂ and O₂ back to H₂O reducing the efficiency of the photocatalytic process.

References

1. Wang, Q.; Domen, K. Particulate Photocatalysts for Light-Driven Water Splitting: Mechanisms, Challenges, and Design Strategies. *Chem. Rev.* 2020, 120, 919-985.
2. Alotabi, A. S.; Small, T. D.; Yin, Y.; Osborn, D. J.; Ozaki, S.; Kataoka, Y.; Negishi, Y.; Domen, K.; Metha, G. F.; Andersson, G. G. Reduction and Diffusion of Cr-Oxide Layers into P25, BaLa₄Ti₄O₁₅, and Al:SrTiO₃ Particles upon High-Temperature Annealing. *ACS Applied Materials & Interfaces* 2023, 15, 14990-15003.

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