

Reactive deposition vs. strong electrostatic adsorption: A key to highly active single atom co-catalysts in photocatalytic H₂ generation

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Single atoms (SAs) have become a highly investigated topic in heterogeneous catalysis. In photocatalysis, they have reached a very high significance as co-catalysts, namely in photocatalytic production of H₂ from aqueous electrolytes. A key issue in terms of exploiting SAs is the deposition approach used to establish the SA state and its stabilization. The most classic approach to achieve maximum dispersion of noble metals on oxide supports is so-called strong electrostatic adsorption (SEA) – it is a backbone of classic catalyst preparation. In catalytic literature it is widely perceived that this SEA approach in general is superior to other approaches due to the strong noble-metal attachment and the high loading that can be achieved while maintaining a high metal dispersion. The concept has accordingly been widely used to attach SA Pt on various oxides, including TiO₂.

In the presentation we show that a reactive attachment based on hexachloroplatinic(IV) acid leads directly to SA configuration with a significant higher specific H₂ evolution activity than achieved with strong electrostatic adsorption – and this is at a significantly lower Pt loading without any post deposition treatment. Due to the significance of the work for the SA-field, we anticipate a particularly wide interest in the materials science and solar energy communities.

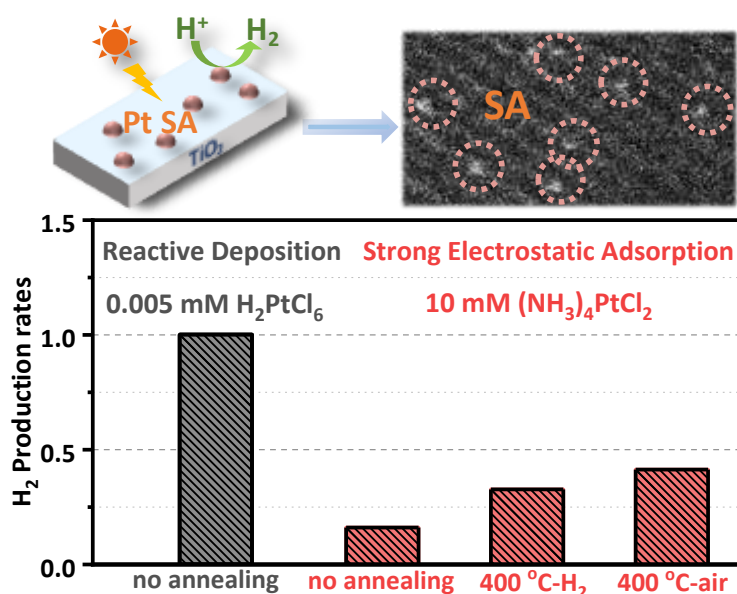


Figure 1. Schematic of the H₂ evolution reaction on Pt single atoms. HAADF-STEM image of Pt-SA-decorated TiO₂ anatase layer. Mass specific photocatalytic H₂ evolution rate for Pt-SA-decorated TiO₂ anatase layers treated under different deposition approaches and post annealing conditions

References

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