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Title: Development of efficient and cost-effective water splitting electrocatalysts for sustainable energy storage

Abstract: Hydrogen (H_2) has been proposed to be the next-generation energy carrier that can find applications in not only stationary power supply but also transportation. The world's first H_2-powered tram has recently begun its commercial operation in China [1], and it is predicted that from 2021 H_2-powered trains will be able to run in Germany [2]. As these H_2-powered vehicles are deployed little by little, the needs for H_2 fuels will be dramatically increased in the future.

Water splitting has proven to be a sustainable way to produce H_2 fuels, especially when renewable energy such as solar and wind is employed as the electrical input. However, widespread deployment of water electrolyzers is prohibited because the noble metal catalysts presently used in electrolyzers are expensive and have low natural abundance, so that the electrolyzed H_2 fuels are not economically competitive to those produced by steam reforming of natural gas. To address this challenge, developing efficient, low-cost and durable water splitting electrocatalysts containing earth-abundant elements is critically important. In this talk, I will present our recent efforts toward developing self-supported transition metal based cathodes and anodes that can efficiently promote the hydrogen evolution (HER) and oxygen evolution reactions (OER), respectively [3-6]. In particular, we have demonstrated that transition metal phosphide electrodes show water splitting performance comparable to the noble metal counterparts, and the best ever operational durability in alkaline solution, namely 3000 hours of continuous water splitting without obvious degradation at an industry-relevant current density. In addition, I will show that these transition metal based catalysts can be coupled with silicon photocathodes to co-catalyze photoelectrochemical water splitting [7, 8].

References:

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