Nickel nanoparticle-activated MoS_2 for simultaneous photocatalytic hydrogen evolution and water purification

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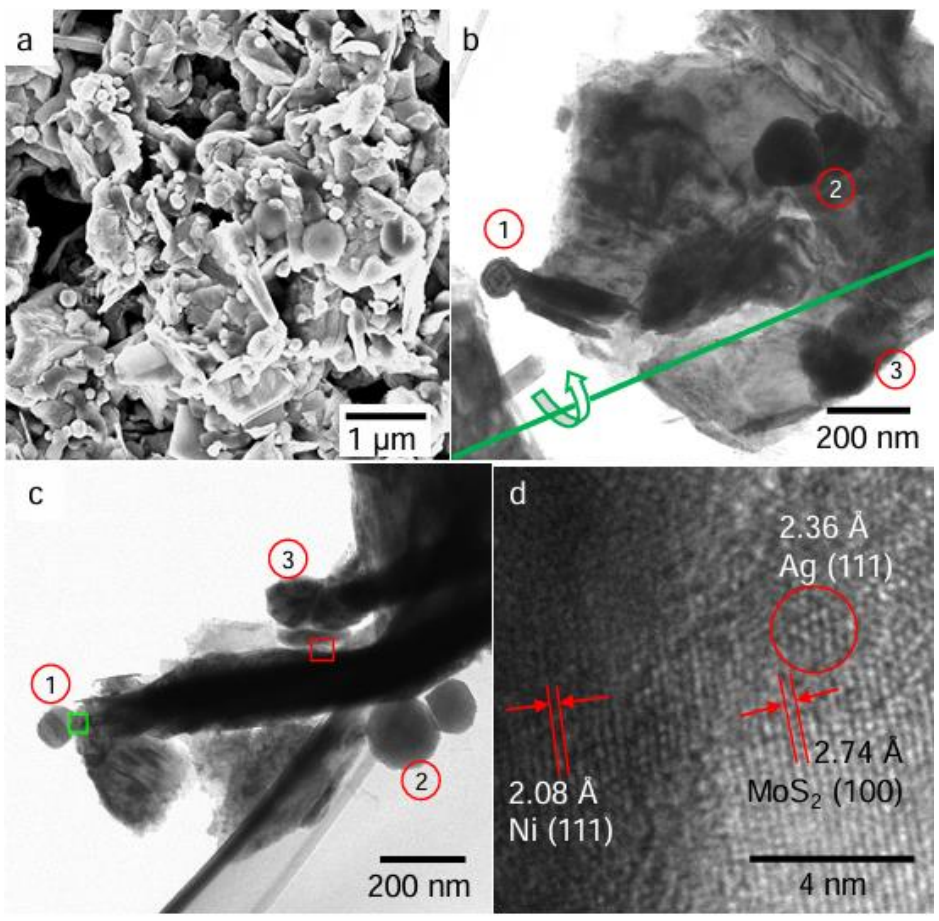
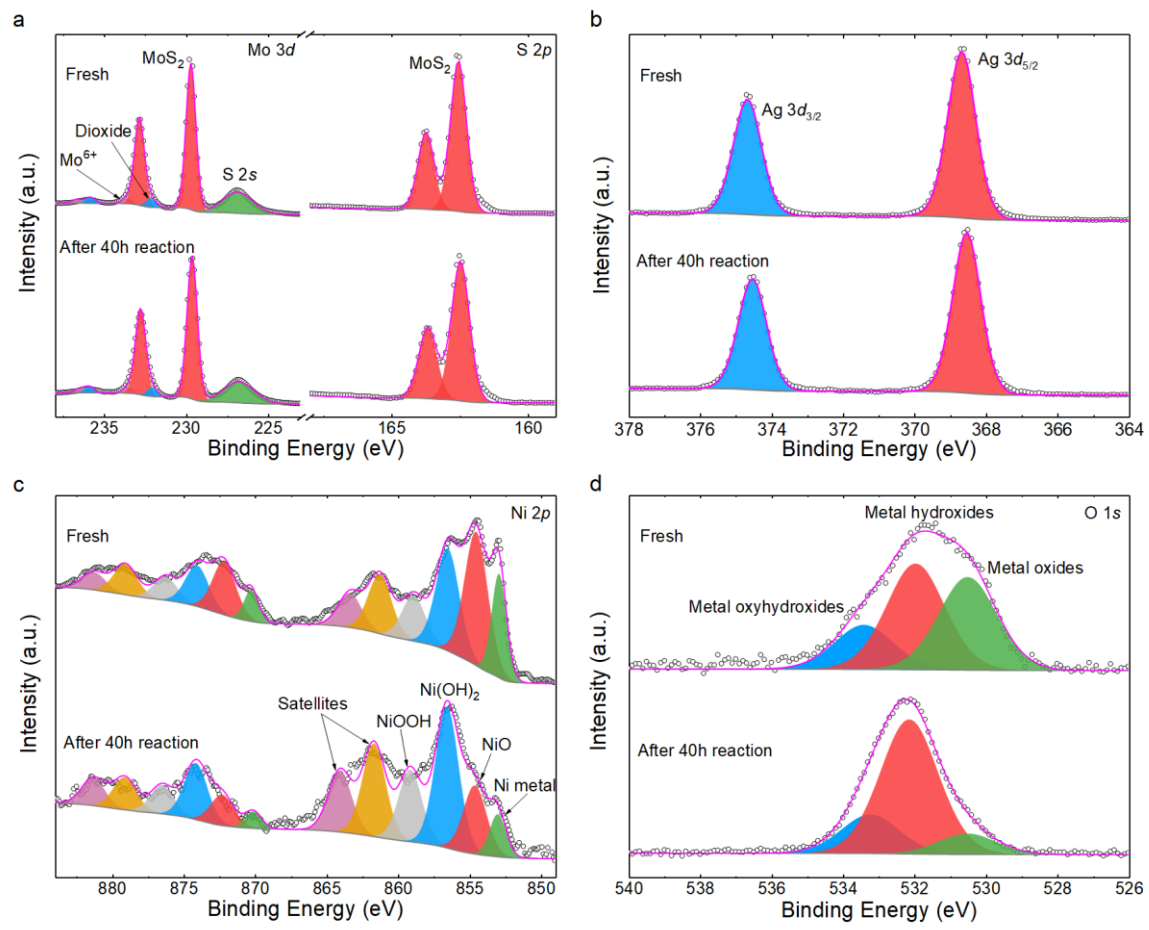
Introduction

Since the inception of water photolysis, the dream has been to convert solar energy into hydrogen using only sunlight, water, and cheap photocatalysts. The sunlight hydrogen evolution reaction (HER) requires a suitable bandgap from the semiconducting catalyst. Undesirable electron–hole recombination should be delayed or suppressed. These stringent conditions may be simultaneously satisfied on a heterojunction composite. Layered MoS_2 is endowed with unique optical and electronic properties, moderate bandgaps as well as immense possibilities for designing structures and functionalities. The edge sites of monolayer MoS_2 have been found to be active for HER and can be engineered by various routes to increase the catalytic efficiency. Here, we report a strategy for multilayer MoS_2 activation for efficient and simultaneous H_2 production and pollutants removal.

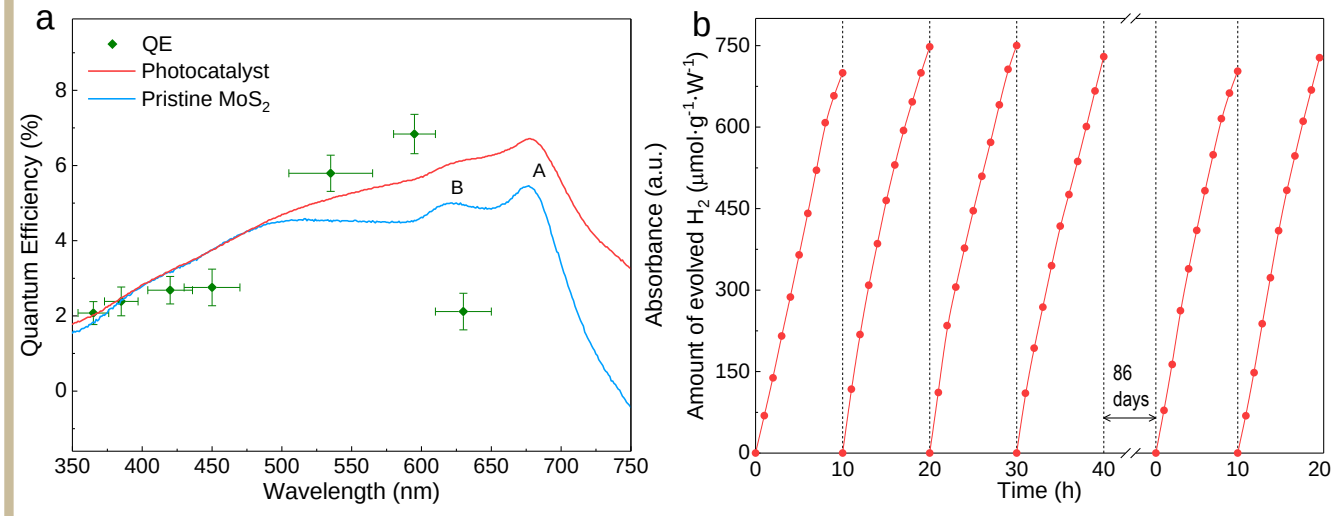
Results



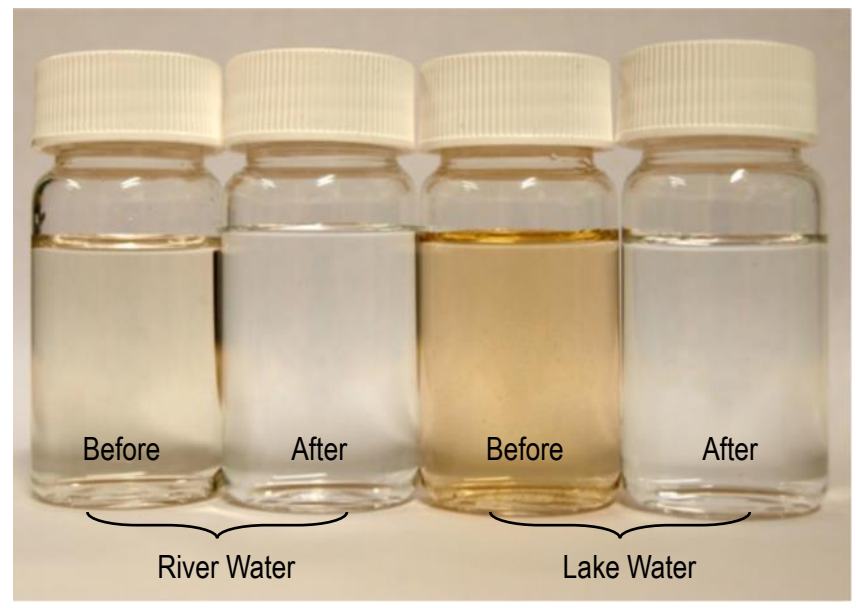
Morphological and elemental characterizations of the samples. (a) SEM image. (b) TEM image. The green line denotes the axis of the TEM specimen holder. (c) The same region as panel (b) with a tilt angle of 62°. (d) HRTEM images of interfacial regions marked with green squares.



XPS spectra of the photocatalyst before and after HER: (a) Mo 3*d* and S 2*p*, (b) Ag 3*d*, (c) Ni 2*p*, (d) O 1*s*. The scatter plots are the experimental results and the grey and magenta lines are the Shirley backgrounds and fitting envelopes, respectively. Each pair of doublet peaks in panel (c) is illustrated with identical colors.



Photocatalytic water splitting ability of the catalysts. (a) Wavelength dependent absorbance and quantum efficiency (QE) of the synthesized photocatalyst and pristine MoS_2. (b) Time course of hydrogen evolution under visible light irradiation ($\lambda > 400$ nm).



Purification of river water and lake water.

Reference

[1] Xinying Shi, Meng Zhang, Xiao Wang, et al. *Nanoscale*, 2022, 14, 8601–8610.