Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Ration design of 0D/3D Sn_3O_4/NiS nanocomposite for enhanced photocatalytic hydrogen generation

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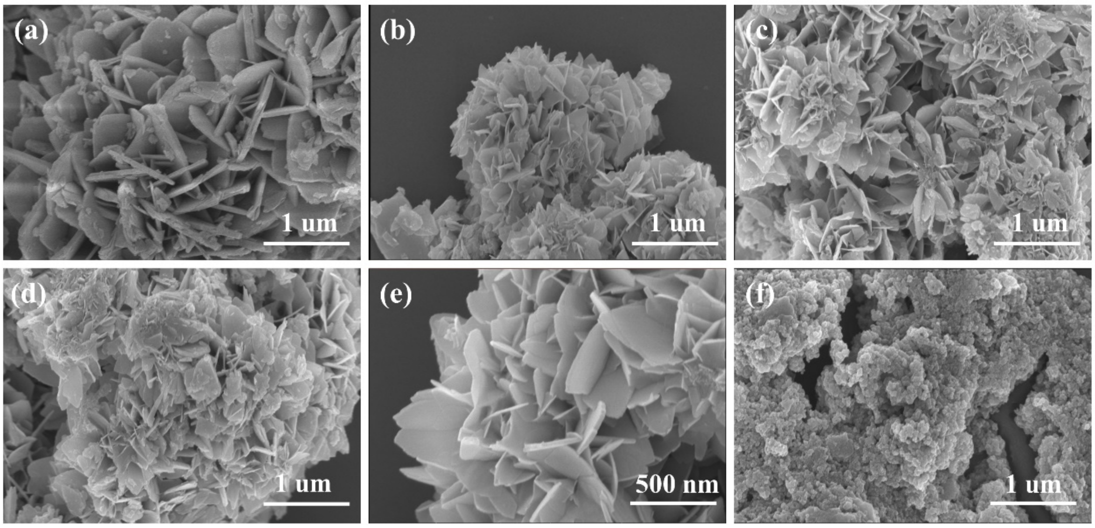

Fig. S1 SEM images of (a-d) Sn_3O_4/0.3% NiS, Sn_3O_4/0.5% NiS, Sn_3O_4/1.5% NiS, Sn_3O_4/2.0% NiS, (e) Sn_3O_4, (f) NiS nanoparticles.

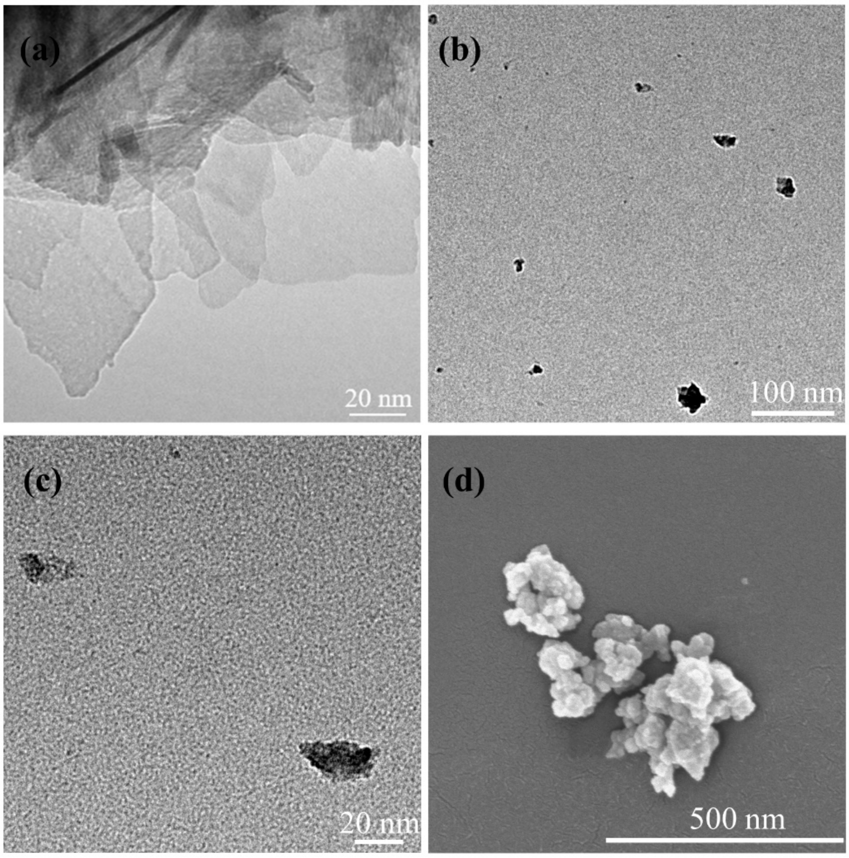

Fig. S2 (a) HRTEM image of the Sn_3O_4, (b) TEM image of the NiS, (c) HRTEM image of the NiS, (d) SEM image of NiS.

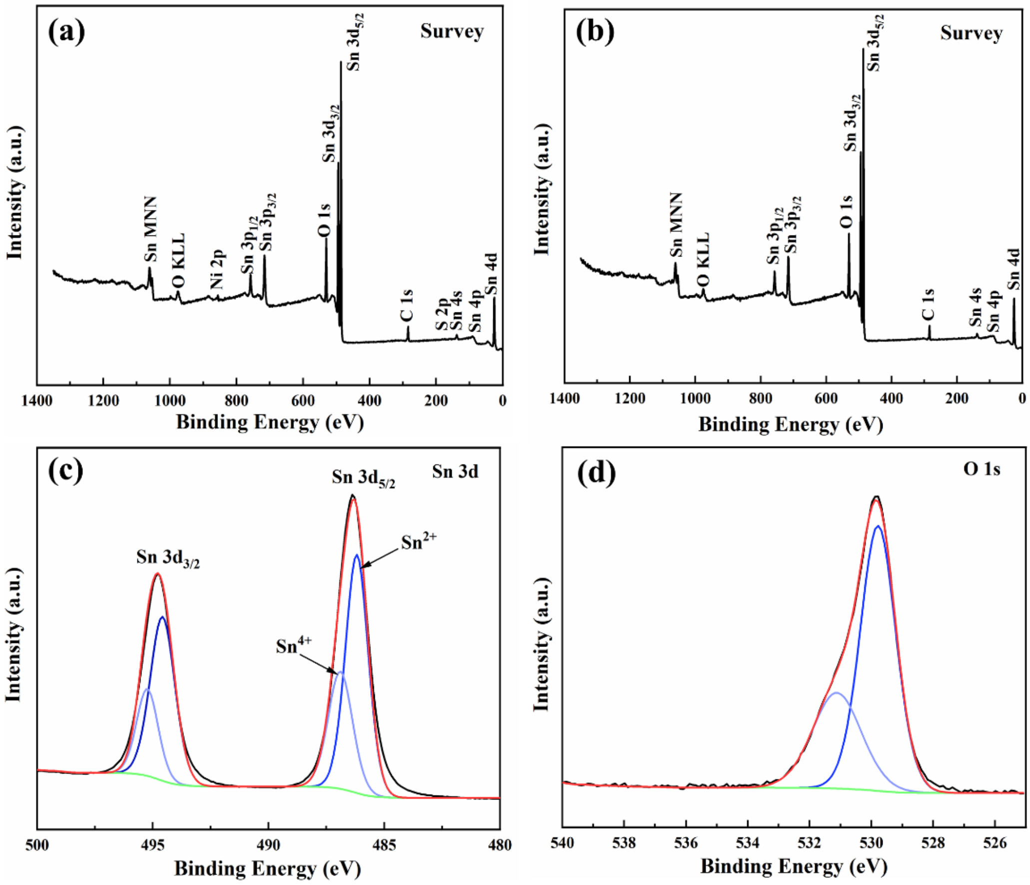

Fig. S3 XPS spectra of Sn_3O_4/1.0% NiS: (a) survey spectrum, XPS spectra of Sn_3O_4: (b) survey spectrum and the high-resolution XPS spectra of (c) Sn 3d, (d) O 1s.

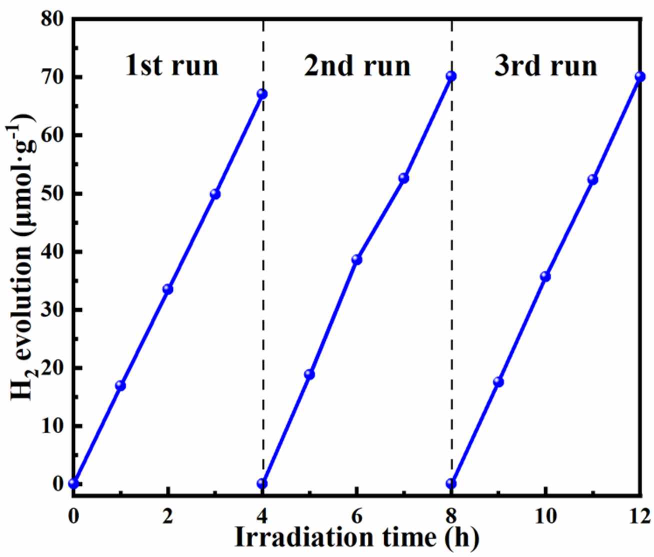

Fig. S4 The cyclic hydrogen production test of Sn_3O_4/1.0% NiS under visible light.

Apparent quantum efficiency (AQE) calculation

Using 300 W Xenon lamp as light source and 420 nm bandpass filter, the hydrogen production after 4 h of light is measured, so as to obtain the apparent quantum rate of photocatalyst. The AQE calculation formula is as follows.[1, 2]

$$\text{AQE (\%)} = \frac{2 \times number\ of\ evolved\ hydrogen\ molecules}{Number\ of\ incident\ phtons} \times 100\%$$

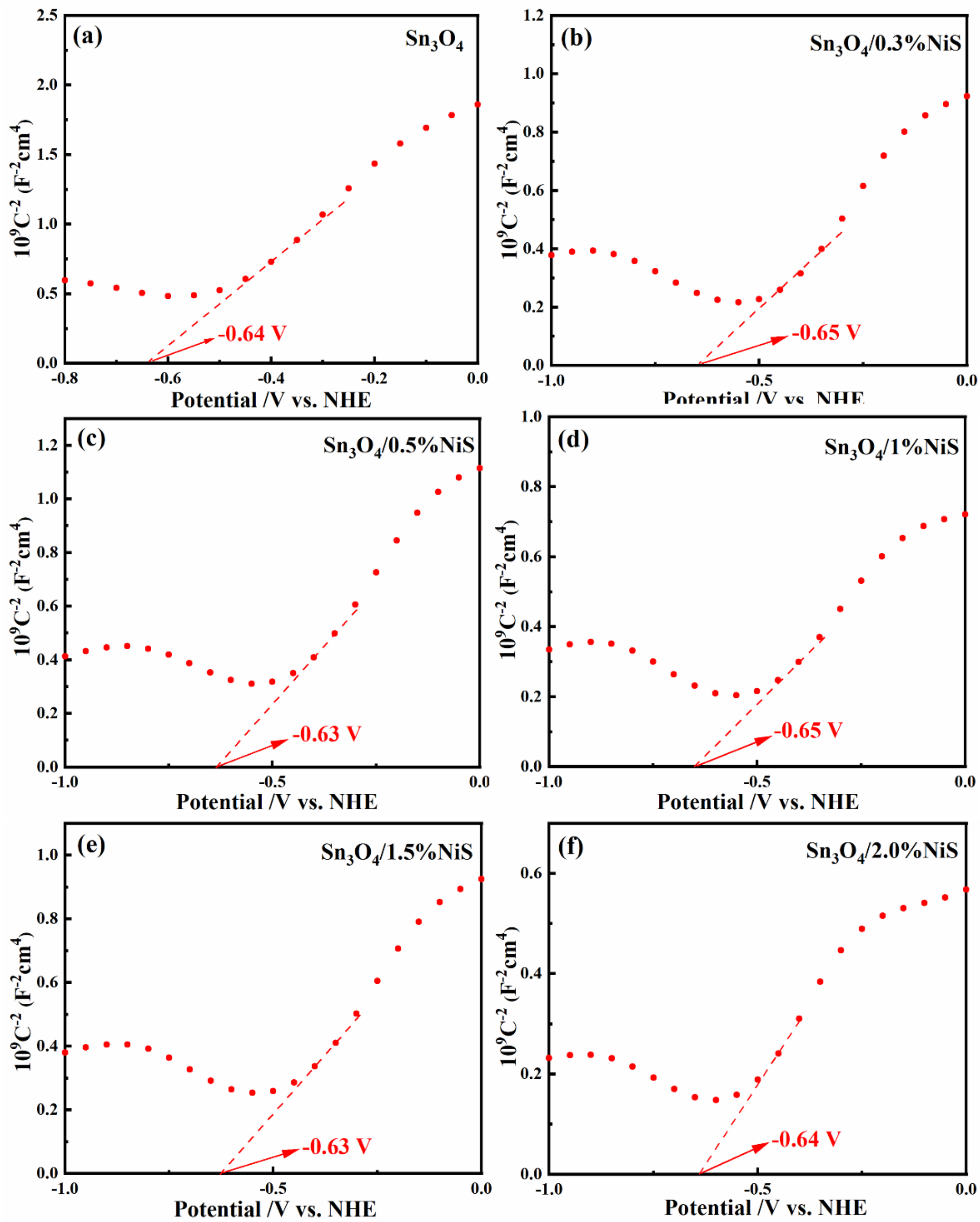

Fig. S5 The Mott-Schottky curve of (a) pure Sn_3O_4, (b) Sn_3O_4/0.3%NiS, (c) Sn_3O_4/0.5%NiS, (d) Sn_3O_4/1.0%NiS, (e) Sn_3O_4/1.5%NiS, (f) Sn_3O_4/2.0%NiS.

Table S1 Summary of hydrogen evolution rates of Sn_3O_4-based materials in recent studies

Sr. No.	Photocatalyst material	Light source	Scavenger	H_2 evolution ($\mu mol \cdot g^{-1} \cdot h^{-1}$)	Ref.
01	Sn_3O_4/NiS	Visible light ($\lambda \geq 420$ nm)	CH_3OH aqueous solution	17.43	This work
02	Sn_3O_4/Pt	Visible light ($\lambda > 400$ nm)	CH_3OH aqueous solution	16.66	Manikandan et al.;[3]
03	Sn_3O_4/TiO_2	Simulated sunlight	CH_3OH aqueous solution	17.00	Yu et al.;[4]
04	Sn_3O_4/rGO	Visible light ($\lambda \geq 420$ nm)	CH_3OH aqueous solution	19.95	Yu et al.;[5]
05	Sn_3O_4 microballs	Simulated sunlight	CH_3OH aqueous solution	8.84	Balgude et al.;[6]
06	Sn_3O_4@$BiVO_4$-QD	Simulated sunlight	CH_3OH aqueous solution	12.10	Chen et al.;[7]
07	Ni doped Sn_3O_4	Visible light ($\lambda \geq 420$ nm)	CH_3OH aqueous solution	14.55	Yang et al.;[8]
08	Sn_3O_4	Visible light ($\lambda > 400$ nm)	CH_3OH aqueous solution	9.00	Tanabe et al.;[9]
09	Phosphoric acid modified Sn_3O_4	Simulated sunlight	Overall water splitting	9.60	Chen et al.;[10]
10	Ultrathin nanosheet Sn_3O_4	Visible light ($\lambda > 400$ nm)	CH_3OH aqueous solution	15.50	Tanabe et al.;[11]

Table S2 Attenuation time and relative amplitude parameters of the Sn_3O_4 and Sn_3O_4/1%NiS, as well as the mean lifetime after fitting accordingly.

Samples	τ_1 (ns)	τ_2 (ns)	A_1 (%)	A_2 (%)	τ_a (ns)
Sn_3O_4	0.166	3.41	780.81	84.67	2.41
Sn_3O_4/1%NiS	1.39	8.142	39.12	13.26	5.70

The mean lifetime of fluorescence emission was measured by a formula $\langle \tau \rangle = \sum_i \frac{A_i t_i^2}{A_i t_i}$.

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