

# Synthesis of Fe<sub>2</sub>O<sub>3</sub> Nanorod and NiFe<sub>2</sub>O<sub>4</sub> Nanoparticle Composites on Expired Cotton Fiber Cloth for Enhanced Hydrogen Evolution Reaction

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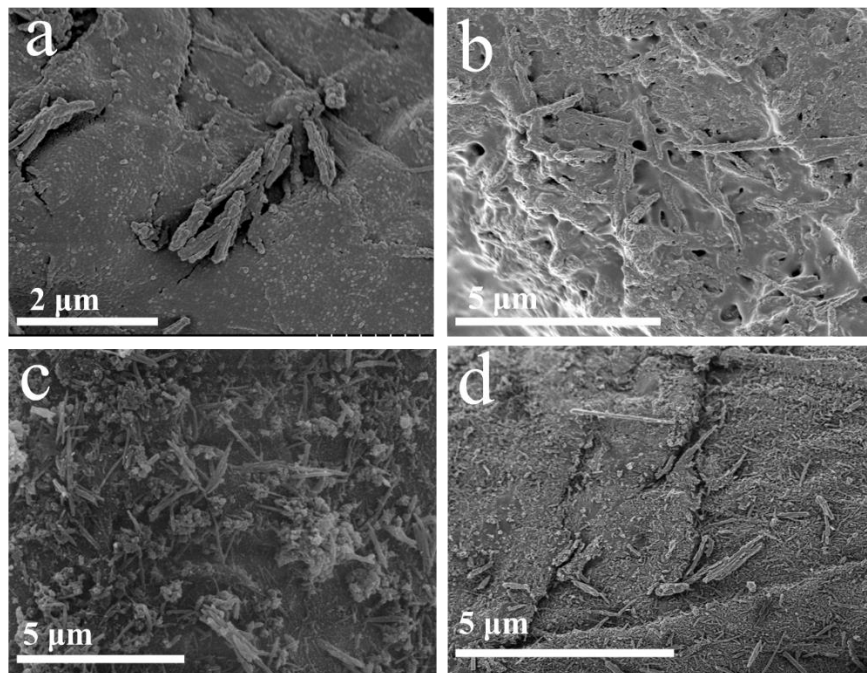
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**Table S1.** Initial precursor used to synthesize different Fe<sub>2</sub>O<sub>3</sub>-NiFe<sub>2</sub>O<sub>4</sub>/CF-X catalysts.

Sample	FeCl <sub>2</sub> ·4H <sub>2</sub> O(g)	NiCl <sub>2</sub> ·6H <sub>2</sub> O(g)
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-1	0.1	0.6
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-2	0.3	0.6
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-3	0.5	0.6
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-4	0.7	0.6
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-5	0.9	0.6
Fe <sub>3</sub> O <sub>4</sub> /CF	0.5	—
NiO/CF	—	0.6

**Table S2.** Catalytic deposited on the CF during synthesis.

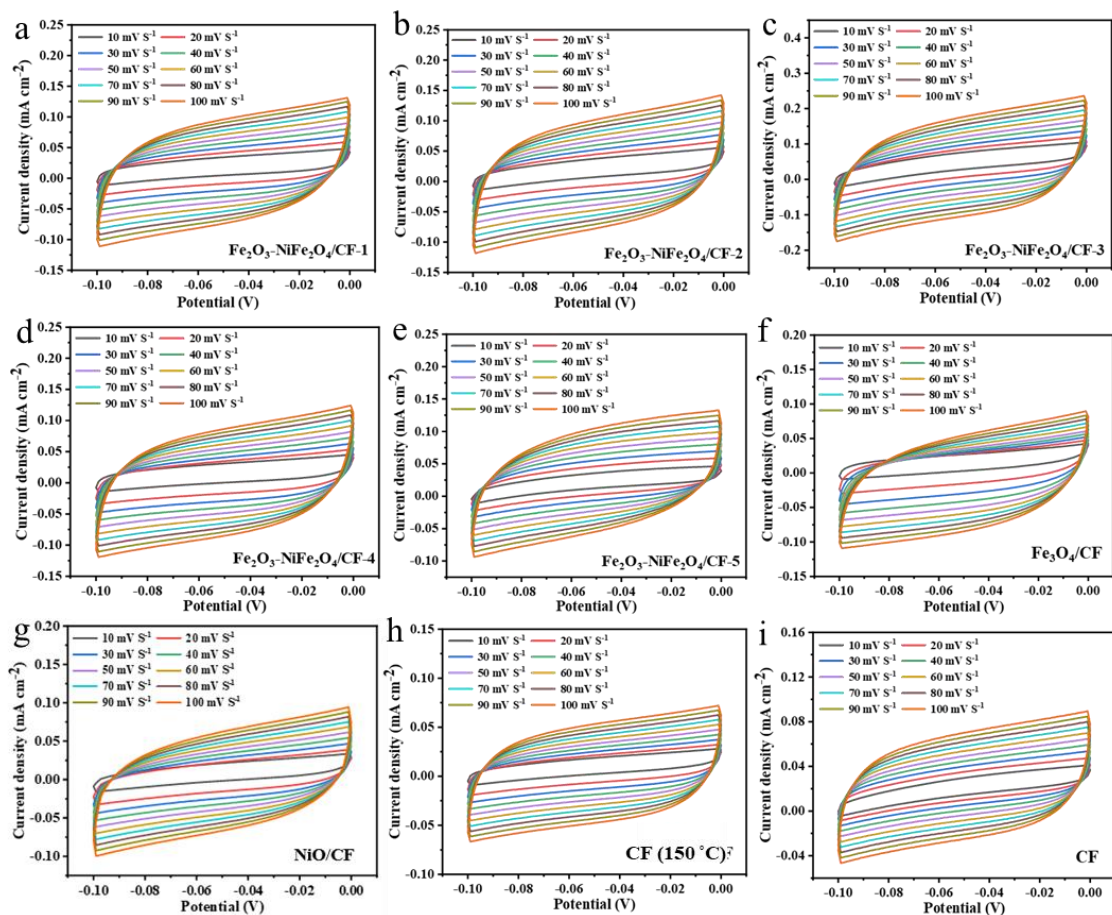
Sample	Catalysts deposits on CF (mg)
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-1	2.1
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-2	3.2
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-3	4.5
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-4	5.8
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-5	6.3
Fe <sub>3</sub> O <sub>4</sub> /CF	1.6
NiO/CF	1.5



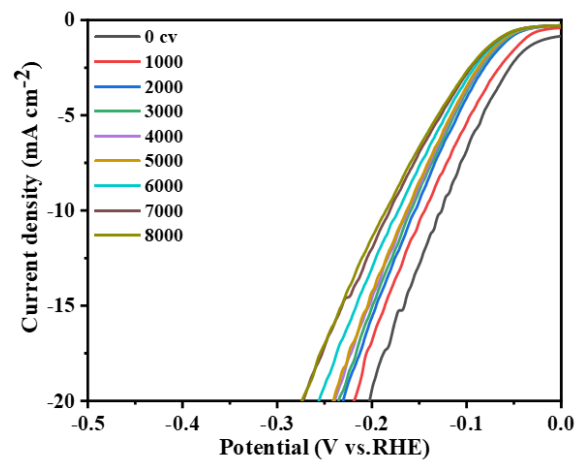
**Figure S1.** SEM image of (a)  $\text{Fe}_2\text{O}_3\text{-NiFe}_2\text{O}_4/\text{CF-1}$ , (b)  $\text{Fe}_2\text{O}_3\text{-NiFe}_2\text{O}_4/\text{CF-2}$ , (c)  $\text{Fe}_2\text{O}_3\text{-NiFe}_2\text{O}_4/\text{CF-4}$ , (d),  $\text{Fe}_2\text{O}_3\text{-NiFe}_2\text{O}_4/\text{CF-5}$  samples.

**Table S3.** Catalytic performance comparison of Fe<sub>2</sub>O<sub>3</sub>-NiFe<sub>2</sub>O<sub>4</sub>/CF-3 sample with previously reported catalysts.

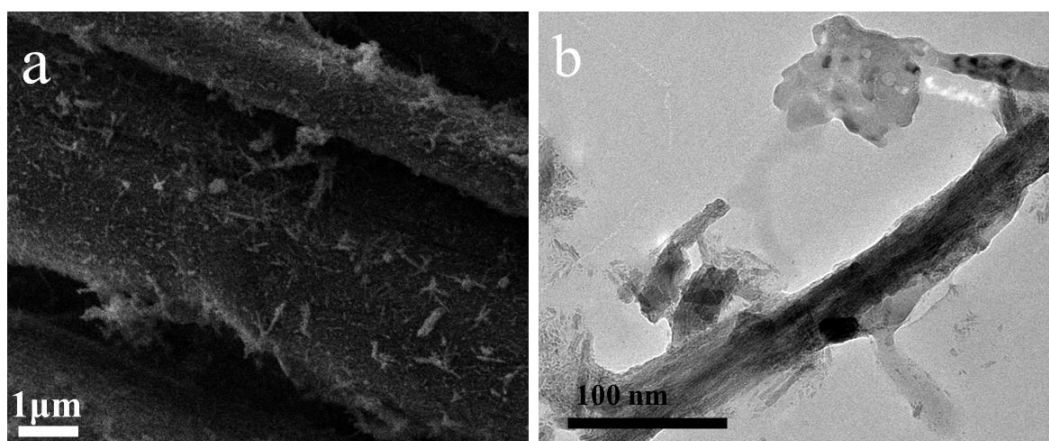
Catalysts	$\eta_{10}$ (mV)	Tafel slope (mV dec <sup>-1</sup> )	Reference
Fe <sub>2</sub> O <sub>3</sub> -NiFe <sub>2</sub> O <sub>4</sub> /CF-3	127	44.9	<b>This work</b>
NiFe <sub>2</sub> O <sub>4</sub> /Ti <sub>3</sub> C <sub>2</sub>	173	112.2	1
NiFe <sub>2</sub> O <sub>4</sub> /CB	187	85.8	2
NiFe <sub>2</sub> O <sub>4</sub> /CoNi-S	149	49.8	3
NiFe <sub>2</sub> O <sub>4</sub> @N-rGO-CC	188	218.5	4
NiFe <sub>2</sub> O <sub>4</sub> @N/rGO-800	157	49.7	5
NiFe <sub>2</sub> O <sub>4</sub> @MOF-74	403	106	6
Co <sub>0.5</sub> Ni <sub>0.5</sub> Fe <sub>2</sub> O <sub>4</sub>	174	91	7
NiFe <sub>2</sub> O <sub>4</sub> /NF	135	122.7	8



**Figure S2.** (a-i) CV curves of as-synthesized samples, CF and CF (150 °C) between -0.1 and 0 V *vs.* Hg/HgO at different scan rate  $\text{mV s}^{-1}$  in 1.0 M alkaline solution. (g) The electrochemical surface area of catalysts was determined from  $C_{dl}$ .  $C_{dl}$  values was calculated by plotting the  $\Delta J = (J_a - J_c)$  at 0.05 V *vs.* Hg/HgO against various scan rates, the  $2C_{dl}$  is equal to the slope.



**Figure S3.** LSV curves of  $\text{Fe}_2\text{O}_3\text{-NiFe}_2\text{O}_4/\text{CF-3}$  catalyst before and after different CV cycles.



**Figure S4.** (a) SEM and (b) TEM images of  $\text{Fe}_2\text{O}_3\text{-NiFe}_2\text{O}_4/\text{CF-3}$  sample after 8000 CV cycles

## References

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