*Electronic Supplementary Information for*

# RE-doped (RE = La, Ce and Er) $Ni_2P$ Porous Nanostructures as Promising Electrocatalysts for Hydrogen Evolution Reaction

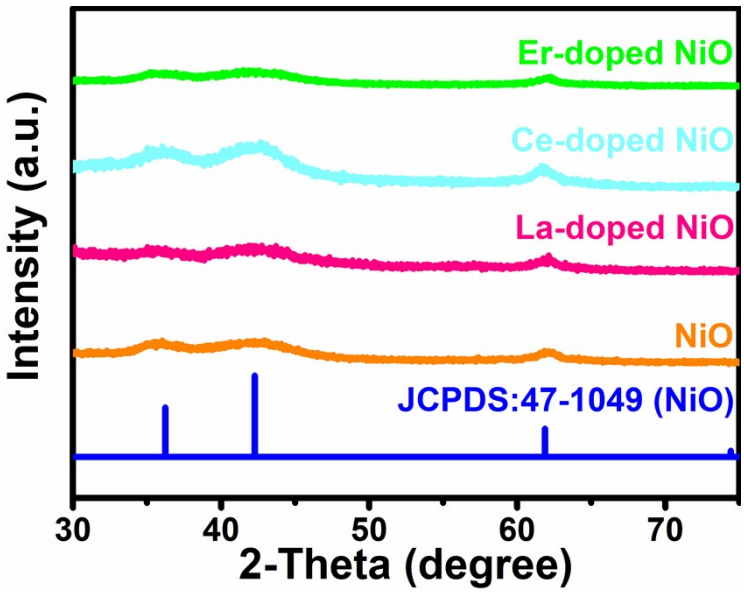
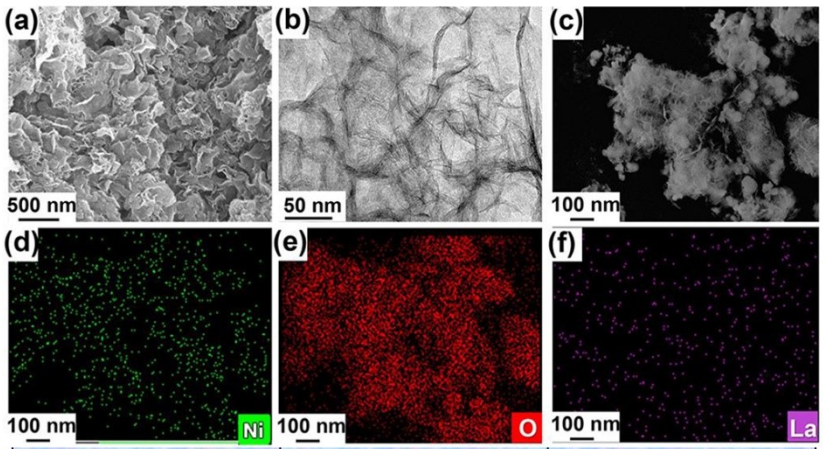


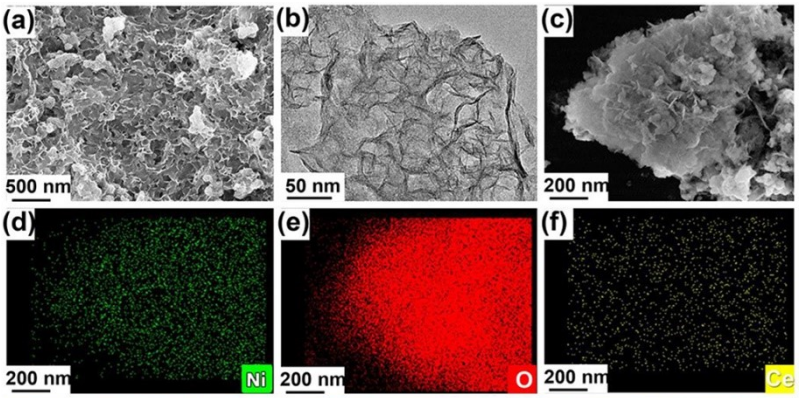

Fig. S1 XRD patterns of NiO and La, Ce and Er-doped NiO nanosheets.




(g)

| Element | Weight (%) | Atomic (%) |
|---|---|---|
| O (K) | 33.67 | 65.30 |
| Ni (K) | 65.16 | 34.44 |
| La (K) | 1.16 | 0.26 |

Fig. S2 (a) SEM and (b) TEM images of La-doped NiO nanosheets; (c–f) EDS elemental mappings of Ni, O and La in the La-doped NiO nanosheets; (g) Summary of the element content of La-doped NiO nanosheets after SEM-EDS analysis.




| (g) Element | Weight (%) | Atomic (%) |
|---|---|---|
| O (K) | 35.92 | 67.29 |
| Ni (K) | 64.05 | 32.70 |
| Ce (K) | 0.04 | 0.01 |

Fig. S3 (a) SEM and (b) TEM images of Ce-doped NiO nanosheets; (c-f) EDS elemental mappings of Ni, O and Ce in the Ce-doped NiO nanosheets. (g) Summary of the element content of Ce-doped NiO nanosheets after SEM-EDS analysis.

| Element | Weight (%) | Atomic (%) |
|---|---|---|
| O (K) | 42.77 | 75.43 |
| Ni (K) | 51.88 | 22.97 |
| Er (K) | 5.35 | 1.60 |

Fig. S4 Summary of the element content of Er-doped NiO nanosheets after TEM-EDS analysis.

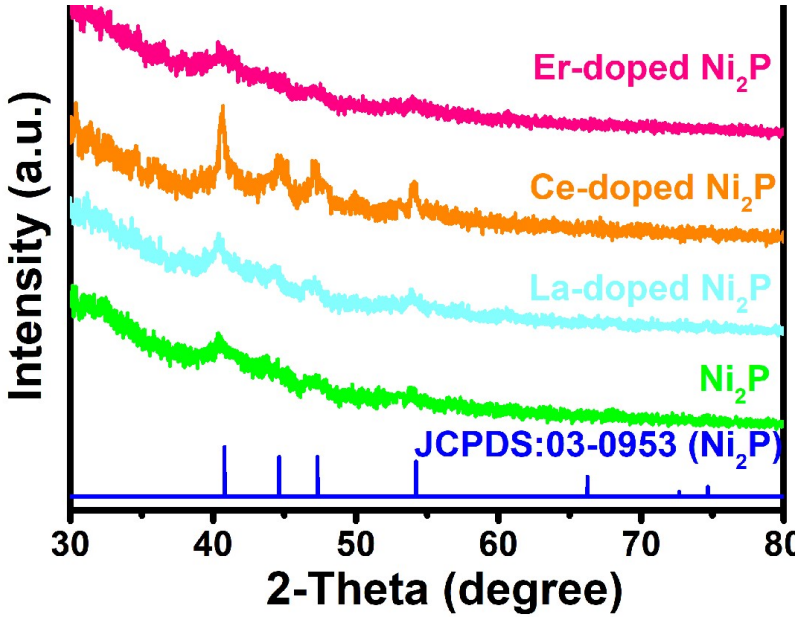
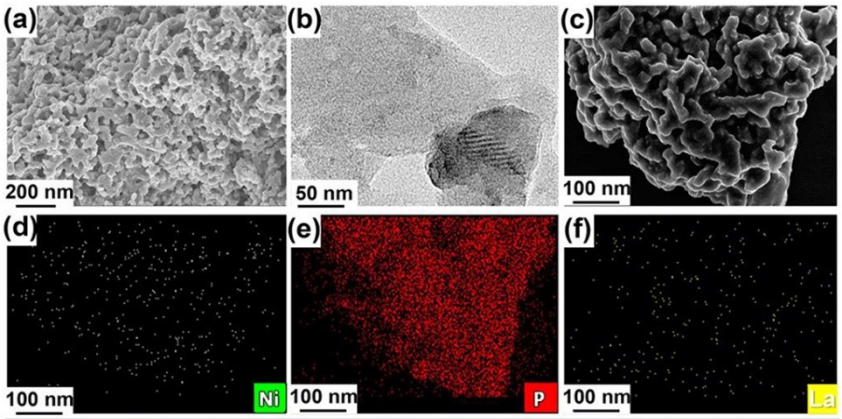
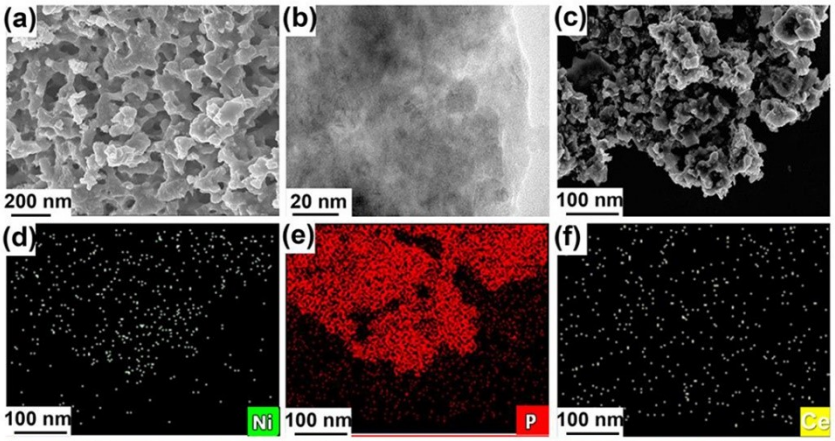



Fig. S5 XRD patterns of $Ni_2P$ and La, Ce and Er-doped $Ni_2P$ porous nanostructures.




| (g) Element | Weight (%) | Atomic (%) |
|---|---|---|
| P (K) | 56.44 | 71.38 |
| Ni (K) | 42.41 | 28.30 |
| La (K) | 1.15 | 0.32 |

Fig. S6 (a) SEM and (b) TEM images of La-doped $Ni_2P$ porous nanostructures; (c–f) EDS elemental mappings of Ni, P and La in the La-doped $Ni_2P$ porous nanostructures. (g) Summary of the element content of La-doped $Ni_2P$ porous nanostructures after SEM-EDS analysis.




| (g) Element | Weight (%) | Atomic (%) |
|---|---|---|
| P (K) | 57.22 | 72.08 |
| Ni (K) | 41.45 | 27.55 |
| Ce (K) | 1.33 | 0.37 |

Fig. S7 (a) SEM and (b) TEM images of Ce-doped $Ni_2P$ porous nanostructures; (c–f) EDS elemental mappings of Ni, P and Ce in the Ce-doped $Ni_2P$ porous nanostructures. (g) Summary of the element content of Ce-doped $Ni_2P$ porous nanostructures after SEM-EDS analysis.

| Element | Weight (%) | Atomic (%) |
|---|---|---|
| P (K) | 35.02 | 53.16 |
| Ni (K) | 62.96 | 44.03 |
| Er (K) | 2.02 | 2.82 |

Fig. S8 Summary of the element content of Er-doped $Ni_2P$ porous nanostructures after TEM-EDS analysis.

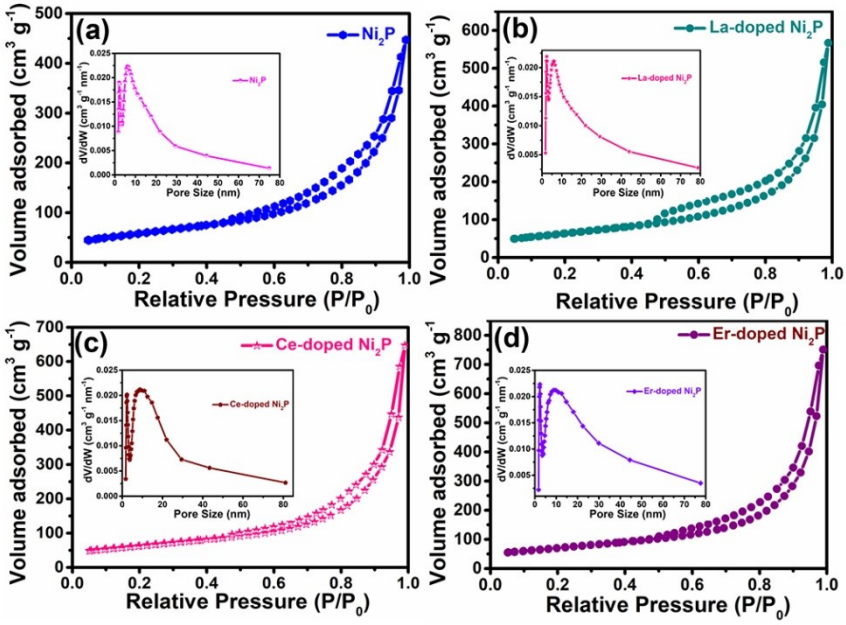



Fig. S9 $N_2$ adsorption/desorption isotherms of (a) pristine $Ni_2P$, (b) La-doped $Ni_2P$, (c) Ce-doped $Ni_2P$ and (d) Er-doped $Ni_2P$ porous nanostructures. Inset: pore size distribution of the corresponding porous nanostructures.

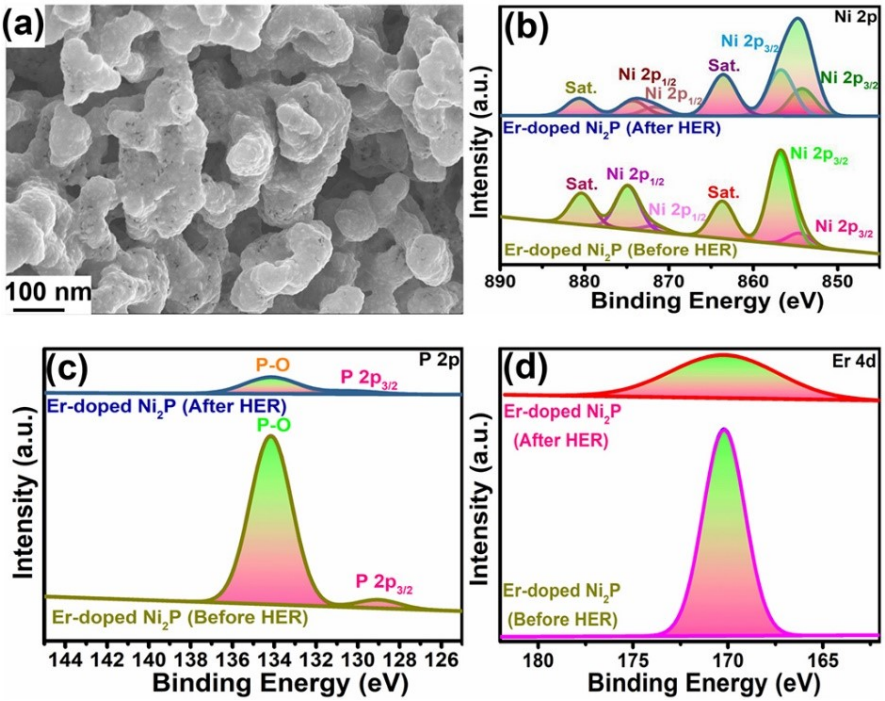



Fig. S10 (a) SEM image of Er-doped $Ni_2P$ porous nanostructures after 30 h HER stability test. XPS signals of (b) Ni 2p, (c) P 2p and (d) Er 4d for the Er-doped $Ni_2P$ porous nanostructures after 30 h HER stability test.

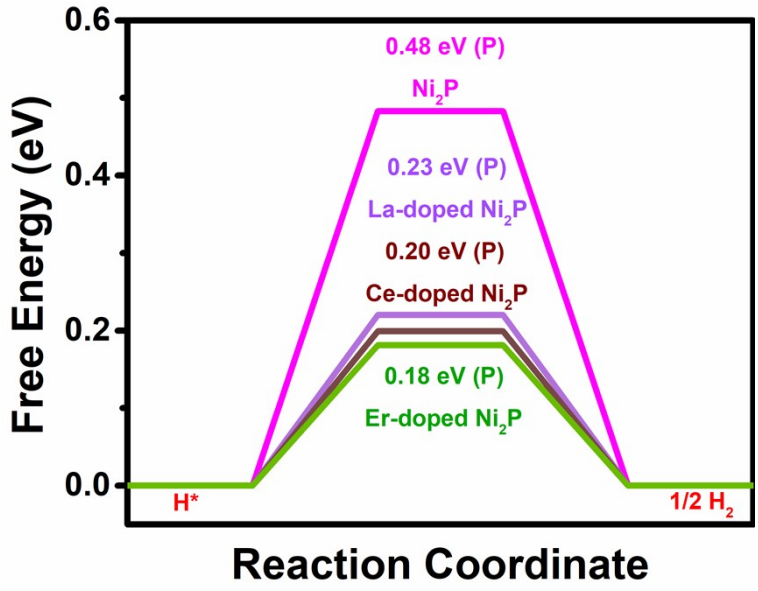



Fig. S11 Free-energy comparison diagram of optimal P active site for HER on (a) pristine $Ni_2P$ (111); (b) La-doped $Ni_2P$ (111); (c) Ce-doped $Ni_2P$ (111); (d) Er-doped $Ni_2P$ (111).