Supporting information

Solar-to-Chemical Fuel Conversion via Metal Halide Perovskite Solar-Driven Electrocatalysis

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**Table S1**. Comparison between MHP photocatalysis and MHP solar-driven electrocatalysis.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| System | Fabrication | Cost | Configuration | Compositions diversity | Reaction conditions | Sacrificial agent | Energy source | Stability | Reusability | Efficiency | Product separation |
| MHP photocatalysis | Facile | Low | Simple, MHP powders | High | Saturated HX solutions; nonpolar or low-polarity solvents | HX, alcohols | Solar | Low | Low | Low | Difficult |
| MHP solar-driven electrocatalysis | Complex | High | Complex, MHP PV-EC, MHP PV-PEC, MHP PEC | Low | Aqueous solutions | None | Solar and electricity(optional) | High | High | High | Facile |

**Table S2.** Half reactions of water splitting and CO2 reduction reaction with the corresponding redox potential.

|  |  |
| --- | --- |
| Reaction | Potential (V) vs RHE |
| 2H+ + 2e- → H2 | 0 |
| 2H2O + 4h+ → O2 + 4H+ | 1.23 |
| CO2 + 2H+ + 2e- → CO + H2O | -0.11 |
| CO2 + 2H+ + 2e- → HCOOH | -0.19 |
| CO2 + 6H+ + 6e− → CH3OH + H2O | 0.04 |
| CO2 + 8H+ + 8e− → CH4 + 2H2O | 0.18 |
| 2CO2 + 12H+ + 12e− → C2H4 + 4H2O | 0.08 |
| 2CO2 + 12H+ + 12e− → C2H5OH + 3H2O | 0.09 |

**Table S3.** Summary of the overpotential of electrodes in MHP PV-EC systems for water oxidation (OER), water reduction (HER) and CO2 reduction (CO2RR).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Electrode | Half reaction | Electrolyte | Over potential at 10 mA/cm2 (mV) | Refg |
| NiFe LDHa | OER | 1 M NaOH | 240 | 26 |
| NiFe LDH | OER | 1 M KOH | 220 | 29 |
| NrGO/NCNTb | OER | 1 M KOH | 200 | 41 |
| NF-8-A/CFPc | OER | 1 M KOH | 267 | 42 |
| NiFe(oxy)hydride | OER | 1 M NaOH | 250 | 32 |
| CoPd | OER | 1 M KOH | 390 | 43 |
| IrO2 | OER | 0.5 M NaHCO3 | 470 | 33 |
| DN-CuOe | OER | 0.2 M Cs2CO3 | 250 | 37 |
| NiFe LDH | HER | 1 M NaOH | 210 | 26 |
| CoP | HER | 0.5 M H2SO4 | 130 | 29 |
| NrGO/NCNT | HER | 1 M KOH | 15 | 41 |
| NF-8f/CFP | HER | 1 M KOH | 106 | 42 |
| Ni4Mo | HER | 1 M NaOH | 100 | 32 |
| TiC/Pt | HER | 1 M NaOH | 37 | 25 |
| CoP | HER | 1 M KOH | 188 | 43 |
| Au | CO2RR | 0.5 M NaHCO3 | 300 | 33 |
| DN-CuO | CO2RR | CO2-saturated 0.1 M CsHCO3 | 600 | 37 |

alayered double hydroxide (LDH); bnitrogen doped reduced graphene oxide(NrGO)/nitrogen doped carbon nanotube(NCNT); cNiFe alloy nanoparticle supported N,S-doped carbon annealed (NF-8-A)/carbon fiber paper(CFP); dcobalt phosphate (CoP); edendritic nanostructured copper oxide (DN-CuO); fNiFe alloy nanoparticle supported N,S-doped carbon (NF-8); g the ref number refers to References in the main text.