

Claims

1. A metal nanocluster modified FeNC catalyst, characterized in that the FeNC catalyst is a Fe single atom catalyst co modified with metal nanoclusters and heteroatoms, and the catalyst is Fe-NC-nM, where $n=1, 2, 3$, and n is the amount of Mg based template.

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2. The FeNC-nM catalyst as claimed in claim 1, characterized in that the catalyst is an FeNC-2M electrocatalyst, $n=2$.

3. The preparation method of the catalyst as claimed in claim 1 or 2, characterized in that it comprises the following steps:

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S1: weigh an appropriate amount of thiosemicarbazide and transfer it to a three necked flask filled with water, then place it in an oil bath and heat it to 60-90°C, stirring for 15 minutes, then take an appropriate amount of magnesium chloride hexahydrate, potassium hydroxide, and acetylacetonone iron in water or ethanol solution and add it to the three necked flask in a certain time and order, after 30 minutes of reaction, add an appropriate amount of agarose and stir for 2-3 hours, after natural cooling, age the obtained solution for 10 hours and freeze dry it;

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S2: place the gel reactant containing $Mg(OH)_2$ and KCl precipitation obtained in step S1 in a N_2 flowing tubular furnace, with a heating rate of 1-5 °C/min, heat it to 300-400°C, keep it constant for 1-3h, and then heat it to 800-1000°C at a heating rate of 3-10 °C/min, keep it constant for 1-3h;

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S3: take out the porous carbon product containing $Fe_4[Fe(CN)_6]_3$ obtained in step S2, acid wash it with 0.25-3M H_2SO_4 for 10-14 hours, then rinse it with deionized water until neutral and filter it, dry it to obtain the intermediate; then place the intermediate in a tube furnace with N_2 flow, with a heating rate of 1-5 °C/min, and heat it to 800-1000°C for 1-3 hours to obtain FeNC catalyst.

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4. The preparation method as claimed in claim 3, characterized in that step S1 specifically comprises:

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S1.1: assemble thiosemicarbazide, agarose, $Fe(acac)_3$ mixed hydrogel;

S1.2: formation of $Mg(OH)_2$ and KCl precipitates in situ, followed by freeze-drying.

5. The preparation method as claimed in claim 3, characterized in that step S2 specifically comprises:
- S2.1: pyrolysis of the dried gel obtained in step S1, decomposition of $\text{Mg}(\text{OH})_2$, reconstruction of KCl, and carbonization of the precursor;
- 5 S2.2: in the production of MgO and KCl templates FeNC@template generate porous carbon anchored to Prussian blue $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$.
6. The preparation method as claimed in claim 3, characterized in that step S3 specifically comprises:
- 10 S3.1: remove templates and excess Prussian blue particles through acid soaking process.
- S3.2: the remaining Prussian blue small particles are redispersed by pyrolysis and stabilized with a large number of N and S atoms from thiosemicarbazide, forming FeNC-nM electrocatalysts decorated with S functional groups and iron
- 15 nanoclusters, $n=1\sim 3$;
- The concentration of sulfuric acid in step S3 is 2 M.
7. The preparation method as claimed in claim 3, wherein the early oil bath step in step S1 is condensation reflux, and the later oil bath step is open.
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8. The preparation method as claimed in claim 3, wherein the mass of hexahydrate magnesium chloride and potassium hydroxide in step S1 is 3.2 g and 1.8 g, thiosemicarbazide is 3 g, acetylacetonone iron is 0.84 g, and agarose is 0.8 g.
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9. The application of FeNC-nM catalyst as claimed in claim 1 or 2 in oxygen reduction.
10. The preparation method according to any one of claims 3-8 is applied in the field of oxygen reduction.