**Preparation of Hydrogen Source COx-free Fuel Cell by Ammonia Decomposition using ZA-5 Wustite Catalyst**

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**Highlights**

* ammonia decomposition, ZA-5 Fe1-xO based catalyst, hydrogen fuel.
* The performance of ZA-5 wustite-based catalyst for ammonia decomposition to produce hydrogen is studied in this paper. The technology of ZA-5 wustite-based catalyst is ripe with low cost. Ammonia decomposition has obvious advantages in process technology, product composition and production cost.
* The ammonia conversion was over 99.9% and the hydrogen production rate reached 189.58 mol H2/(gcat·h).

**1. Introduction**

Hydrogen is regarded as a clean energy source with broad application prospects. Hydrogen fuel cells are the most promising new generation energy supply system[1-3]. Currently, hydrogen production and storage technologies are solved by ammonia decomposition. In other word, storage of hydrogen is in liquid ammonia.

At present, the widely used catalysts for ammonia decomposition in industry are Ru or Ni catalysts supported on MgO and A12O3. Although the Ru-based catalyst has high activity, it is costly and the Ni-based catalyst consumes a large amount of electricity and is severely corroded. Therefore, this paper uses a new low-temperature and high-efficiency ammonia synthesis ZA-5 Fe1-xO catalyst to study the performance of ammonia decomposition hydrogen production.

**2. Methods**

 Promoters and fine magnetite powder and the reduced iron powder was mixed uniformly. Then the mixture is putted into the electric melting furnace at one time. After melting, the high temperature slurry is rapidly poured into the cooling tank with water jacket and cooled to room temperature, then broken and sifted to the desired particle size.

**3. Results and discussion**

 The effect of the main factors of reaction temperature and space velocity on the ammonia decomposition activity of ZA-5 Fe1-xO-based catalyst was carried out. The effects of temperature (450-600 °C) and space velocity (900-7800 h-1) on the ammonia decomposition activity over ZA-5 Fe1-xO- based catalyst were investigated.

**a**

**Figure. 1**(a)The conversion of ammonia over ZA-5 Fe1-xO-based catalyst as a function of reaction temperature at different space velocity; (b) Comparison of ammonia decomposition conversion for ZA-5, Ru/AC and Ni catalysts

 It is observed from Figure.1a that the conversion of ammonia decomposition increases with the increase of temperature and decreases with the increase of space velocity. When the temperature reaches 500°C, the ammonia conversion reaches more than 99.7% at all investigated space velocity. If the temperature continues to rise, the ammonia conversion will have little difference, which because the ammonia conversion is close to the equilibrium conversion.

 The activity of ZA-5, Ru/AC and Ni/γ-Al2O3 catalyst produced by an enterprise was determined under the same conditions. The conversion is shown in Figure.1b. It can be seen from Figure.1b that the low temperature activity of Ru/AC catalyst below 500 °C is obviously higher than that of ZA-5 catalyst, but the difference is not significant above 500 °C and the price is high. While the activity of Ni/ γ-Al2O3 catalyst is very bad.

**4. Conclusions**

 The performance of ZA-5 Fe1-xO based catalyst for ammonia decomposition was studied. The results showed that the ammonia conversion was over 99.9 % and the hydrogen production rate reached 189.58 mol H2/(gcat·h), and compared with Ru/AC and Ni catalysts. The cost of raw material, catalyst and investment cost of industrial plant for ammonia decomposition hydrogen production were analyzed. H2 obtained from ammonia decomposition does not contain harmful substances such as COx, SOx, NOx. Ammonia is liquid at room temperature and 0.8 MPa with high energy density per unit volume. Therefore, the combination of ammonia and Fe catalysts with fuel cells is a perfect combination.

**References**

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