Green hydrogen production from catalytic ammonia decomposition

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Why Ammonia?

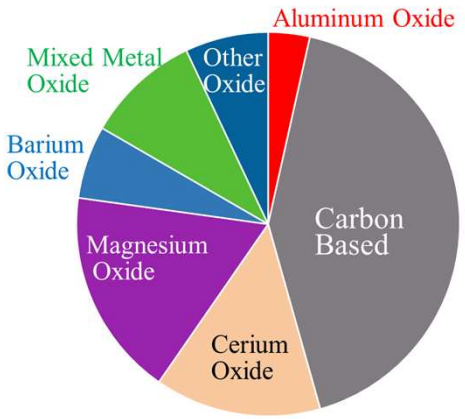
- Ammonia is a potential H_2 carrier with high H_2 capacity (17.8 wt-% H_2).
- Ammonia has easy storage in inexpensive and low-pressure containers.
- Ammonia has well-established distribution and handling procedures.

Research Background

Catalysts play a pivotal role in the decomposition of ammonia at mild reaction conditions to produce green hydrogen

From the literature, we come to know as;

1. Ru-based catalysts are efficient for ammonia decomposition at lower temperature conditions.
2. The performance of the Ru catalyst is greatly affected by the material's properties as support.



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Only few studies on mixed oxide or layered oxide materials. In this study, CeO_2 impregnated Al_2O_3 supports were used to fabricate Ru catalysts. The synthesized catalysts were applied to ammonia decomposition.

Experimentation

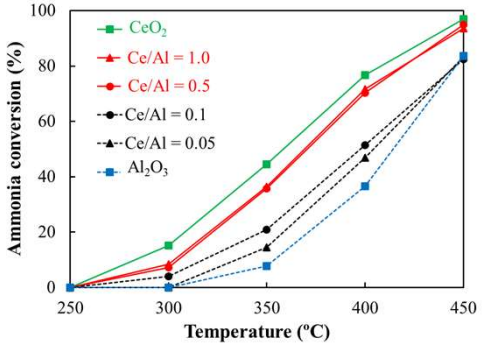
Catalyst synthesis

- CeO_2 was loaded on surface of γ-Al_2O_3 by impregnation.
- CeO_2-impregnated γ-Al_2O_3 supports were prepared in various Ce/Al molar ratios of 0.05-1.0.
- 1 wt-% Ru was loaded on CeO_2-impregnated γ-Al_2O_3 supports by impregnation method.

Ammonia decomposition reactor

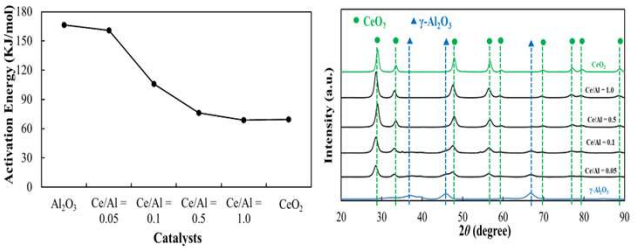
- Single channel packed bed reactor was used.
- GC-TCD was used for analysis of H_2 and N_2 produced.
- Temperature: 250-450°C; Pressure: atmospheric; SV: 5400 h^{-1}.

Results and discussion

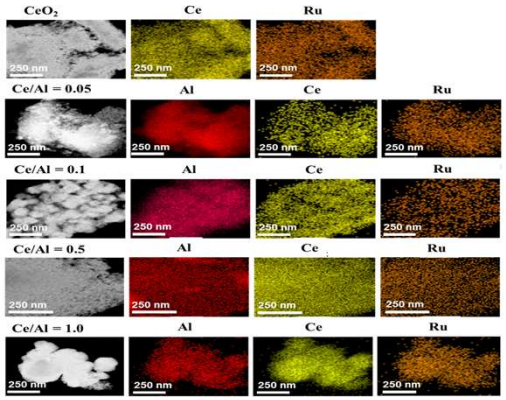


- Ru on γ-Al_2O_3 showed the lowest activity.
- Ru on CeO_2/γ-Al_2O_3 with Ce/Al molar ratios 0.5 and 1.0 showed comparable activity to pure CeO_2-supported Ru catalyst.

Results and discussion



- Surface areas of Ru/CeO_2/γ-Al_2O_3 catalysts with Ce/Al molar ratios 0.5 and 1.0 are close to pure CeO_2-supported Ru catalyst.
- XRD results of Ru/CeO_2/γ-Al_2O_3 catalysts with Ce/Al molar ratios 0.5 and 1.0 are close to pure CeO_2-supported Ru catalyst.



- The surface of Ru/CeO_2/γ-Al_2O_3 catalysts with Ce/Al molar ratios 0.5 and 1.0 are highly covered with CeO_2.
- Therefore Ru/CeO_2/γ-Al_2O_3 catalysts with Ce/Al molar ratios 0.5 and 1.0 show comparable activity to Ru/CeO_2 catalyst.

Summary and Conclusion

- Physical and chemical characteristics of Ru/CeO_2/γ-Al_2O_3 catalysts with Ce/Al molar ratios of 0.5 and 1.0 are close to those of a pure CeO_2-supported Ru catalyst.
- Ru/CeO_2/γ-Al_2O_3 catalysts with lower amount of CeO_2 present cost-effective and efficient catalysts.

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