Study of SiC-core catalyst with high thermal stability

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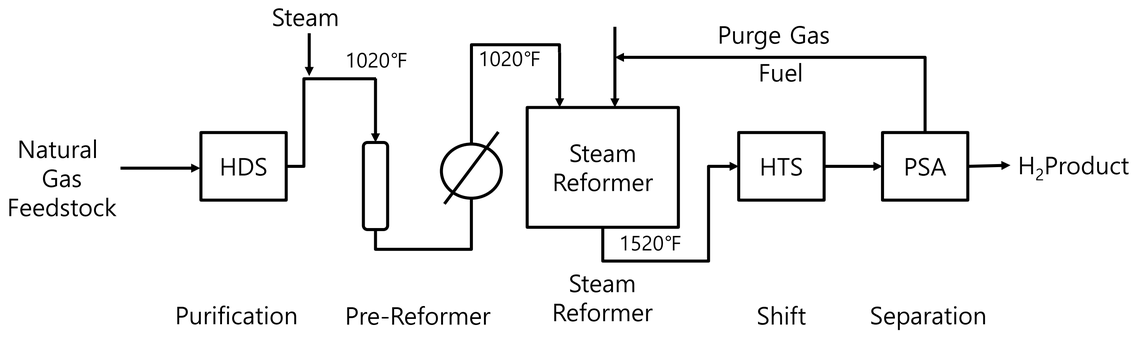
Introduction



$$CH_4 + H_2O \rightarrow CO + 3H_2 \quad \Delta H_R^o = 206\ \text{kJ/mol}$$

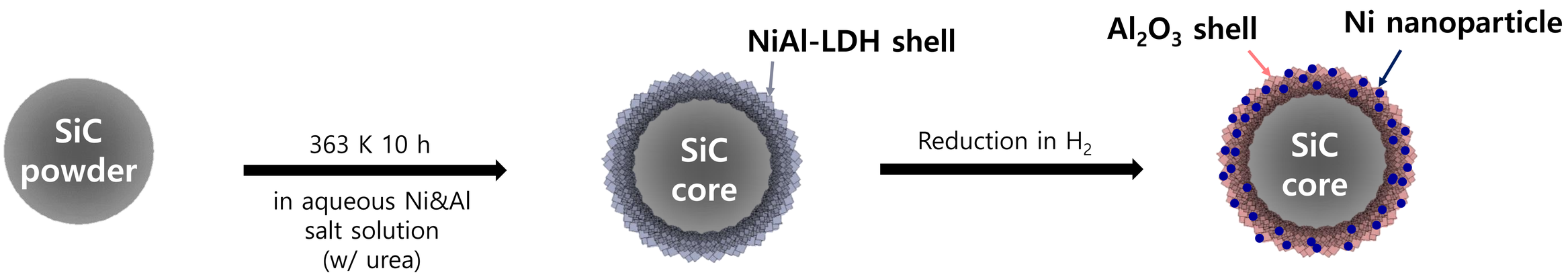
Since the SMR process proceeds at high temperature and involves strong endothermic reaction, the catalyst with high melting point and thermal conductivity is required.

Steam methane reforming has long been one of major process for obtaining hydrogen from natural gas. However, the high temperature conditions and endothermic reactions of the process limited the use of catalysts.

- The high thermal conductivity of catalyst can prevent hot spots and cold spots in highly endothermic and exothermic reactions. It improves the activity and stability in highly endothermic and exothermic reactions.
- SiC is greatly stable at high temperature.

Catalysts with SiC core can get high thermal conductivity, so can provide enhanced activity and stability during highly endothermic/exothermic chemical reactions to require high reaction temperature.

Experimental



SiC particles

NiAl-LDH@SiC Core-shell microstucture

Ni/Al_2O_3@SiC Core-shell catalyst

Results & Discussion

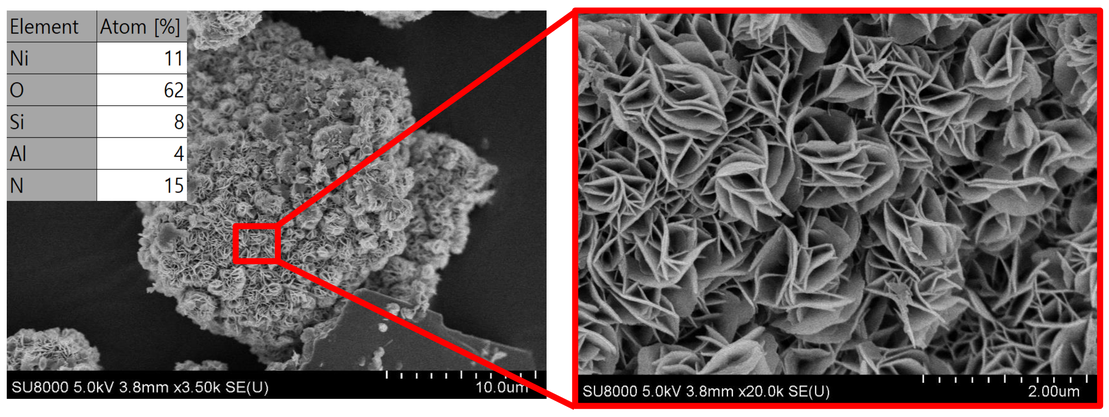


Fig. 1. SEM images after synthesis

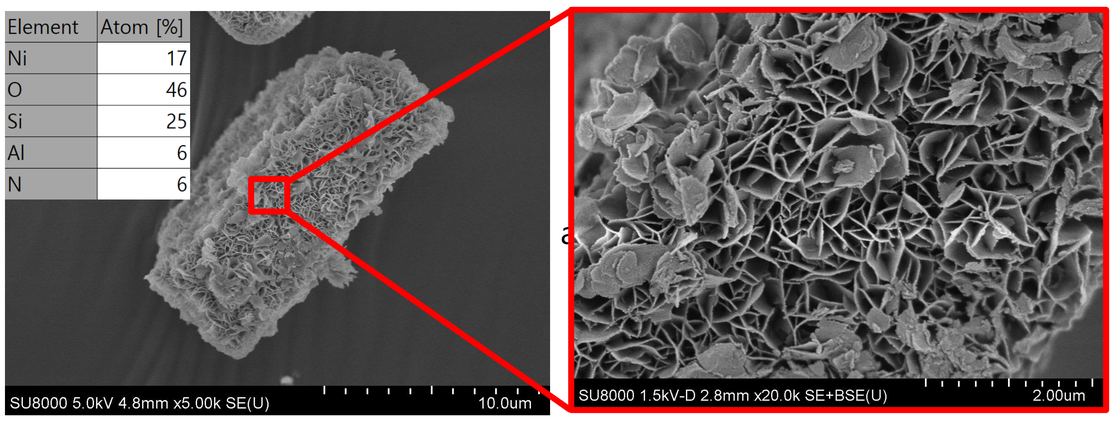


Fig. 2. SEM images after calcination at 650℃

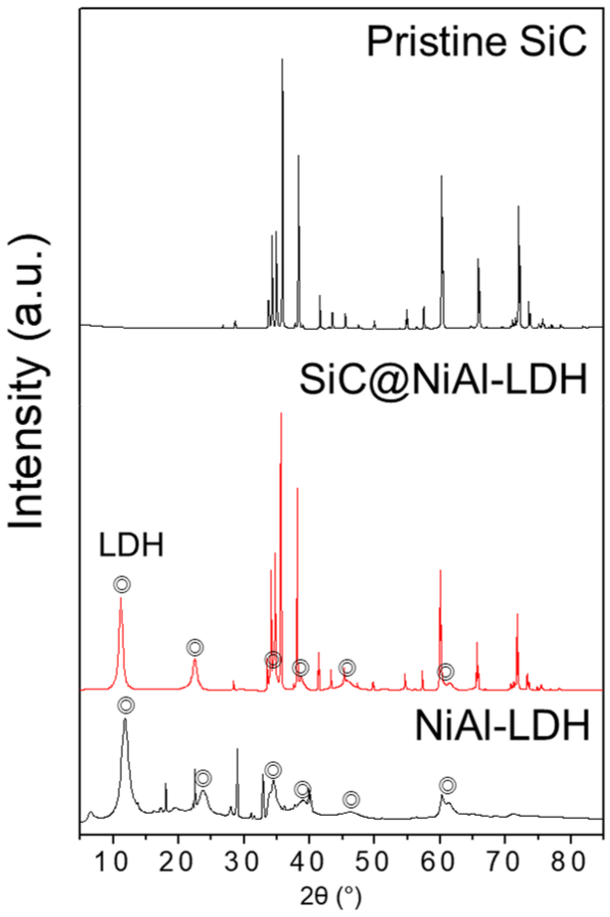


Fig. 3. Confirmation of LDH synthesis by XRD

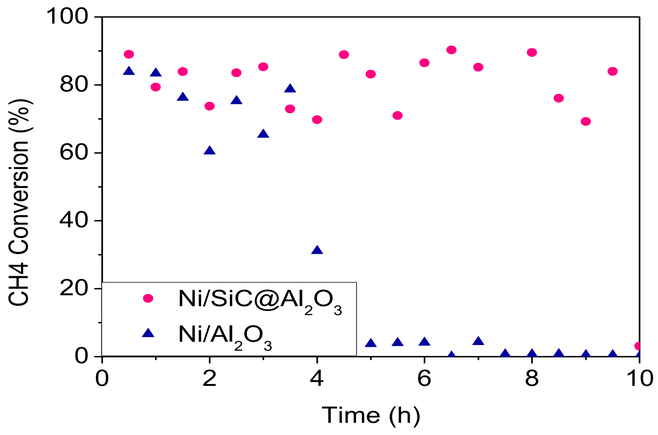


Fig. 4. Effect of SiC core in SMR activity test

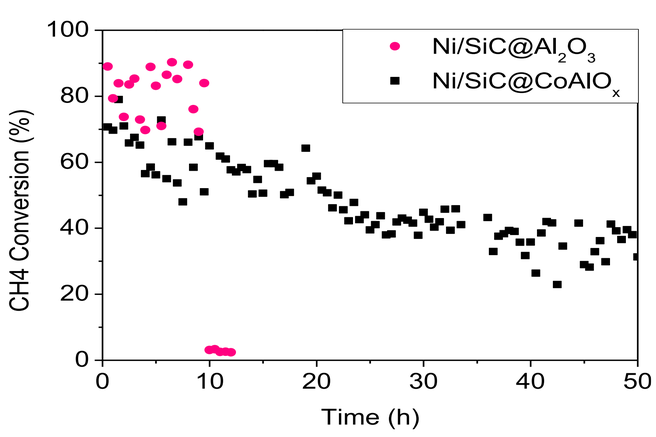


Fig. 5. Effect of loading of Co in SMR activity test

Conclusion

- Ni nano catalysts with silicon carbide core showed good thermal stability due to high thermostability, thermal conductivity and dispersity of nickel.
- Addition of small amount of cobalt in catalytic synthesis step reduced sintering and coking at high temperatures.