Thermal plasma sprayed catalysts in the cleaning of the gasification gas

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BACKGROUND

ü In thermal plasma spraying a coating powder is heated near or above its melting point in a plasma torch and accelerated towards the substrate by a plasma stream.

ü With thermal plasma spraying catalyst coatings with high adhesion can be prepared especially on metal based substrates.

→ Advantages such as high mechanical strength as well as enhanced heat and electric conductivity could be achieved.

EXPERIMENTAL

ü In this study four nickel catalysts were prepared using new coating and reconstitution technology (Fig. 1):
- ü two with nickel on hydrotalcite coating on gibbsite core (Fig. 2)
- ü two with nickel on hydrotalcite coating on boehmite core (Fig. 2)

ü As the reference catalyst a nickel on modified zirconia (8 w-%) as a monolithic form was prepared.

ü The activities of the catalysts were tested in a quartz tube laboratory reactor using a synthetic gasification gas mixture at 700 and 900 °C under atmospheric pressure.

ü The simulated gas contained CO, CO_2, C_2H_4, CH_4, H_2, N_2, H_2O, H_2S, NH_3, O_2 and tar. A mixture of naphthalene and toluene was used as a tar model compound.

RESULTS

ü All the catalysts showed high activities in tar and ammonia decomposition without H_2S in the feed at 900 °C (Fig.3).

ü With H_2S addition, the activities of the gibbsite based catalysts (G-65-Ni, G-85-Ni) towards tar as well as ammonia were higher compared to the boehmite based catalysts (B-65-Ni, B-85-Ni).

ü With H_2S in feed at 900 °C the highest tar model and ammonia conversions, above 90% and ~ 80%, respectively were obtained with G-65-Ni.

ü The activity of G-65-Ni at 900 °C was comparable with the reference catalyst.

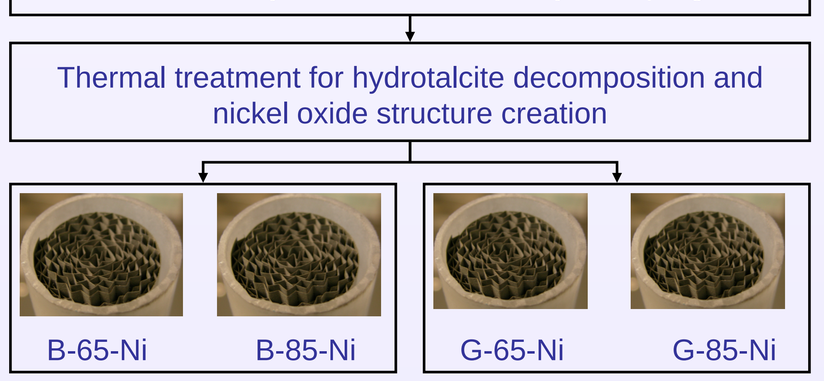
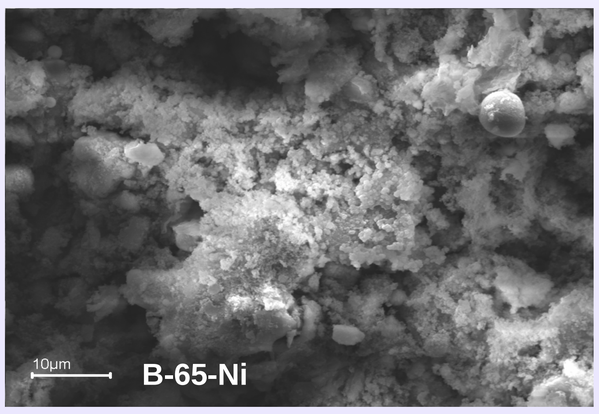
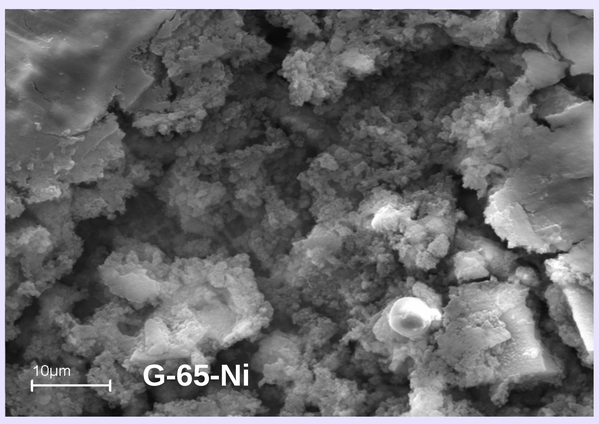


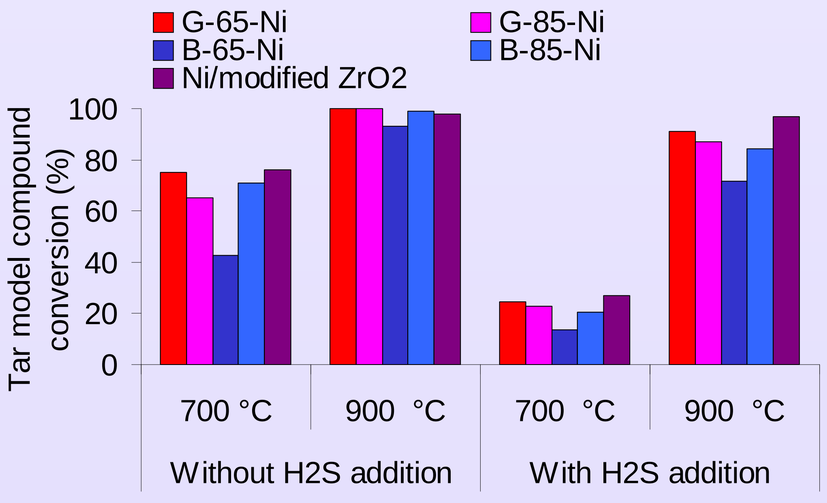
Figure 1. Plasma sprayed catalyst preparation.





	Weight %			
Sample	**O**	**Mg**	**Al**	**Ni**
B-65-Ni	**38.7**	**3.5**	**40.9**	**6.9**
G-65-Ni	**28.6**	**10.7**	**38.0**	**4.8**

Figure 2. Chemical analysis of selected samples by SEM/EDS.



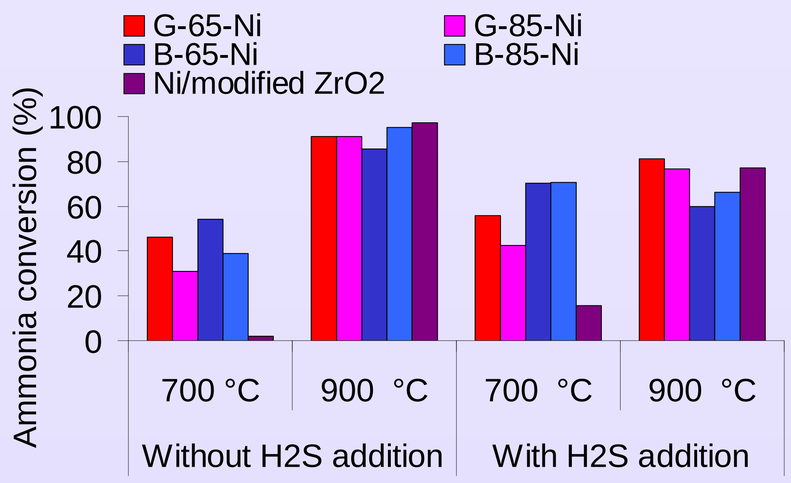


Figure 3. Conversion of tar model compound and ammonia on different catalysts.

CONCLUSIONS

ü High conversions of the tar model compound and ammonia were measured with the catalysts utilizing the plasma spraying technology.

ü The activity towards tar was comparable also with 10 w-% Ni/Al_2O_3 catalyst [2].

ü Plasma spraying is a good alternative for preparing catalysts for applications such as gasification gas cleaning and others, which require high thermal stability as well as mechanical strength of the catalysts.

REFERENCES

[1] Khinsky, A., WO2004079035, 16th of September 2004.
[2] Juutilainen, S., Simell, P., Krause, O., *13th International Congress on Catalysis*, Book of Abstracts **2**, 122, Paris, France, 2004.

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