Catalytic study of metal loaded H-AAS over phenol hydrogenation/hydrodeoxygenation

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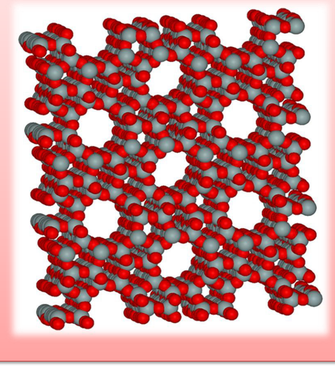


Abstract:

In this work, Amorphous ZSM-5 zeolite-based aluminosilicates (AAS) have been synthesized with metal loading over it to enhance catalytic activity. Metal Ni (5wt%) and W/Mo (1wt%) as promoter has been used to impregnate which was calcined at 500°C. These amorphous and low-crystallinity zeolites were hydrothermally synthesized at low temperature (95°C) without autoclave, with Si/Al ratios 15.87. These AAS have been characterized by powder XRD, SEM-EDS and total number of acidic sites by potentiometric titration.The catalytic activity of Ni-AAS is to be tested for hydrogenation/ hydro-deoxygenation of phenol cracking to explore selectivity towards formation of light alkanes. Based on the response of the optimized catalyst/reaction conditions it may be employable to phenols generated during application to potential raw material, lignin.

Introduction:

Amorphous aluminosilicate is a synthetic substance that is used as a catalyst/catalyst support. Some of alumina is present in tetrahedral coordination as shown by NMR studies Si MASNMR and Al NMR. It contains both Bronsted and Lewis acidic sites which are distinguished by formation of complex that signifies Lewis acid while formation of pyridinium ion signifies presence of Bronsted acidic sites.

❑The activity and product selectivity of acidic zeolite catalysts depend strongly on the number, strength and nature of the acid sites present besides the shape and size of the micropores and also on composition ratio of (Si/Al).

❑ AAS catalyst is widely used in the cracking (Fischer Tropsch) of waxes towards the production of liquid fuels at petrochemical industry because of porosity and high acidic character of AAS on product yields.

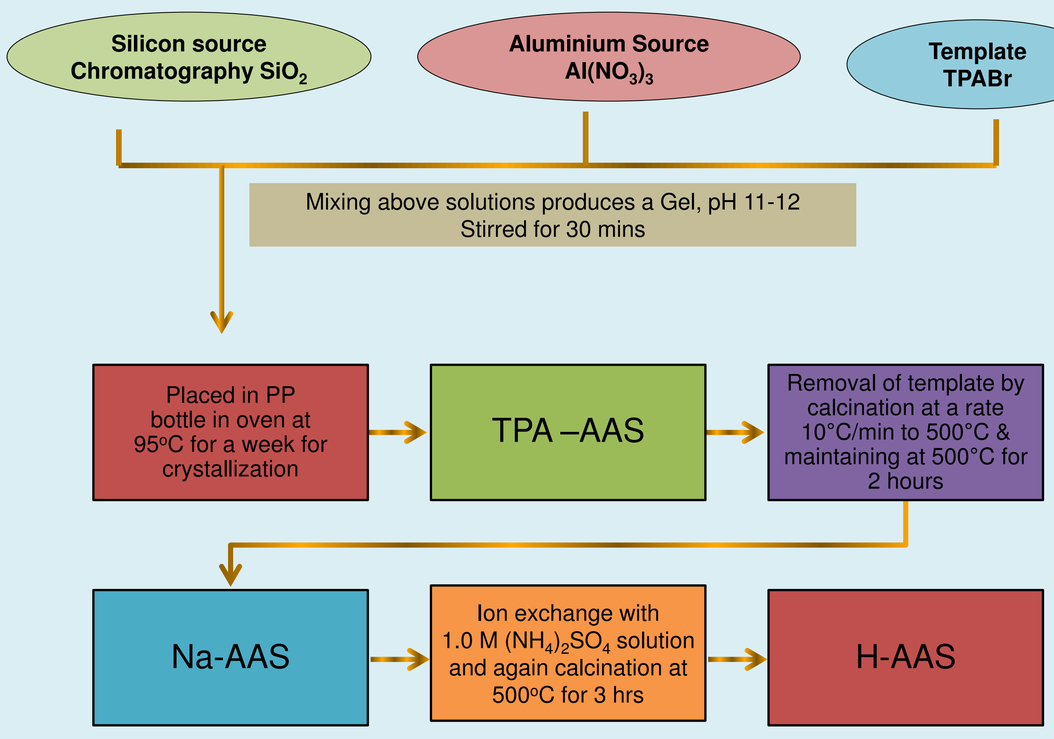
Objective:

❑ Aqueous phase hydrogenation/hydro-deoxygenation of phenol i.e.(Lignin model compound).Lignin is a complex material consisting largely of oxygenated 4-propylphenolic units crosslinked via phenyl ether bonds, as well as by C–C and other C–O bonds. It is usually seen as underutilised waste product of pulp and paper industry and lignocellulosic biorefineries.

❑ AAS is to be used as a selective catalyst component for the quantitative hydro-deoxygenation of diversely substituted lignin-derived mono- and binuclear phenols.

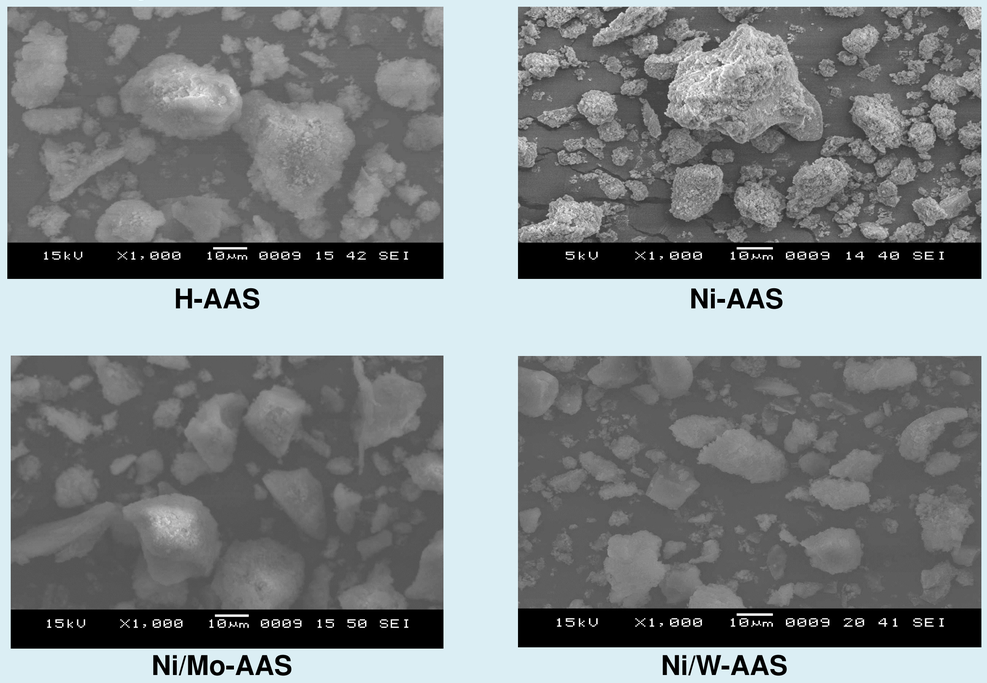
❑ The fundamental goal would be to achieve a conversion of phenol into light weight hydrocarbons that are physically and chemically compatible with petroleum-based hydrocarbon fuels.

Synthesis Scheme:

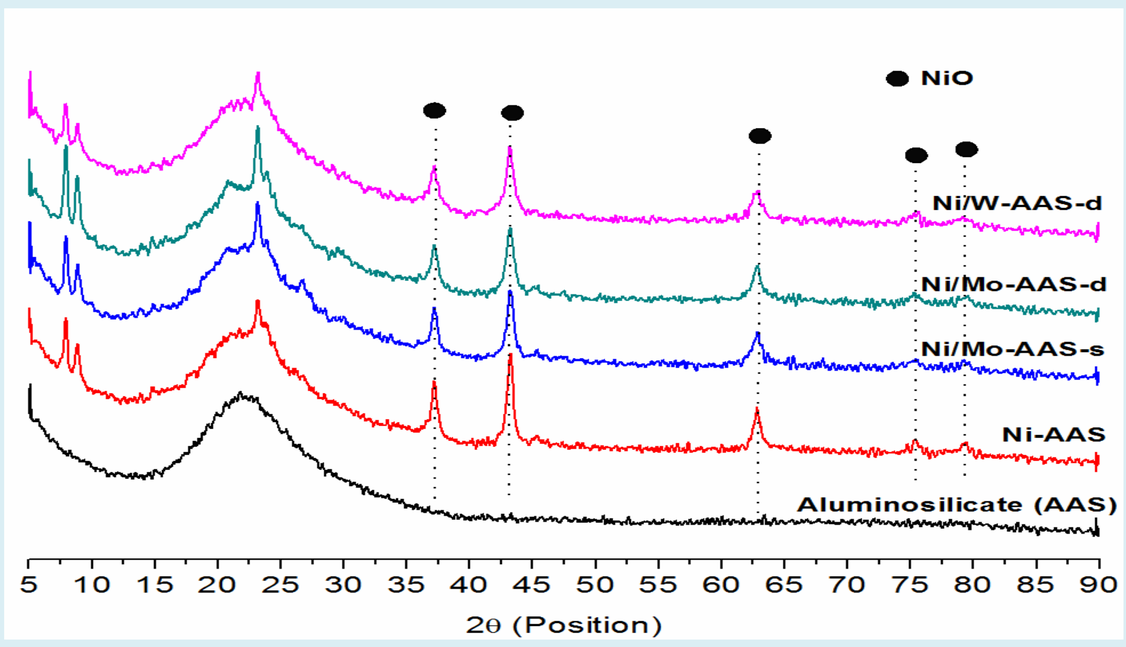


Results:

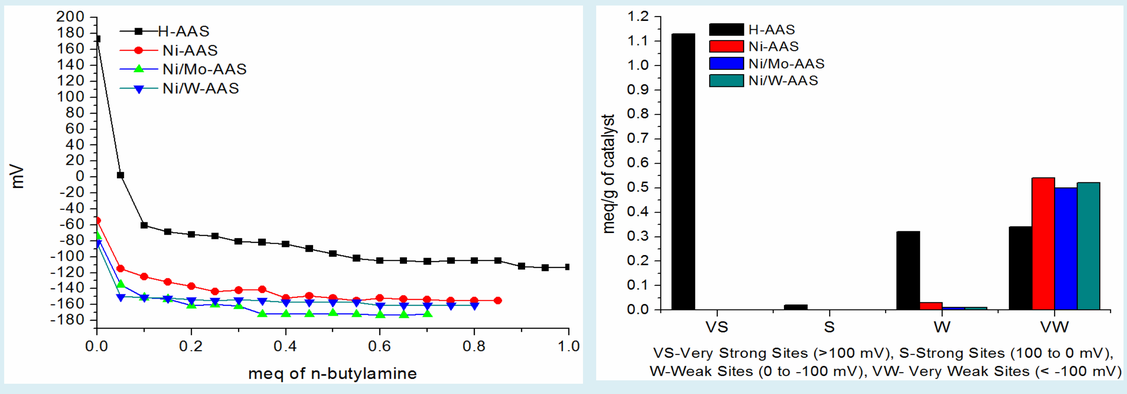
SEM-EDS analysis:



2) XRD analysis:



3) Acidity Analysis:



Conclusions:

Present study shows that H-AAS can be synthesized with high acidic sites and Ni(5wt%), W/Mo(1%) impregnated to perform catalytic activity, without autoclave using chromatography silica as Si source and $Al(NO_3)_3$ as alumina source. The impregnation of metal may enhance the catalytic activity and selectivity towards phenol hydrogenation/ hydro-deoxygenation.

References:

1) J. Scherzer, Catal. Rev.—Sci. Eng. 31 (1989) 215.
2) J.P. Gilson, E.G. Derouane, J. Catal. 88 (1984) 538.
3) K. Barta, G. R. Warner, E. S. Beach and P. T. Anastas, Green Chem., 2014, 16, 191.
4) T.A.J. Hardenberg, L. Mertens, P. Mesman, H.C. Muller, C.P. Nicolaides, Zeolites 12 (1992) 685.

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