Precipitation of cobalt molybdates on activated carbons for catalytic applications

M. Zgrzebnicki[1], A. Albrecht[2], A. Jurkowski[2], P. Adamski[2,*]

[1] *Department of Catalytic and Sorbent Materials Engineering, West Pomeranian University of Technology in Szczecin, Pulaskiego street 10, 70-322 Szczecin;*
[2] *Department of Inorganic Chemical Technology and Environment Engineering, West Pomeranian University of Technology in Szczecin, Pulaskiego street 10, 70-322 Szczecin*
[*] *The corresponding author e-mail: adamski_pawel@zut.edu.pl*

INTRODUCTION

In order to meet economical requirements for industrial processes, transition metals nitrides are being investigated as a new generation of catalysts. Their purpose is to replace expensive noble metals [1]. Typical industrial processes, which could use nitrides, are hydrotreatment reactions, oxidation and ammonia synthesis. The latter one, currently based on the Haber-Bosch process, uses a Fe-based catalyst and requires pressures near 200 bar and temperatures above 673 K. Nowadays, it is responsible for approximately 2% of global energy demand. Therefore, new catalysts are required to optimise this technology. Cobalt molybdenum nitrides are possible catalysts to reduce energy consumption by NH_3 synthesis [2].

This research presents a preparation procedure for cobalt molybdate supported on activated carbon, which could be transformed into a nitride form.

EXPERIMENTAL

Following materials were used: $Co(NO_3)_2 \cdot 6H_2O$, $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$ and activated carbon (AC) Organosorb 10CO as a support. According to the previous study [3], AC was washed with water to remove soluble inorganic compounds. Prior the precipitation, separate solutions of Co and Mo compounds were heated up to 95°C. The final precipitation step was performed in the presence of supporting material. Samples with following ratios of cobalt and molybdenum compounds to AC were prepared (calculated as metallic Co and Mo per cetalyst mass): 0.07, 0.11, 0.14, 0,17 and named: CoMo_AC_1, CoMo_AC_2, CoMo_AC_3 and CoMo_AC_4, respectively.

Materials were analysed with the XRD technique and nitrogen adsorption at 77 K. These analyses provided informations about crystallographic structure, specific surface area (S_{BET}) and pore volumes.

Table 1. Textural properties of obtained samples.

Sample	S_{BET} [m^2/g]	Pore volume [cm^3/g]		
		V_{total}	V_{micro}	V_{meso}
CoMo_1_1	25	0.08	-	-
CoMo_AC_1	1183	0.51	0.39	0.07
CoMo_AC_2	1033	0.43	0.35	0.05
CoMo_AC_3	953	0.42	0.32	0.05
CoMo_AC_4	899	0.41	0.30	0.06

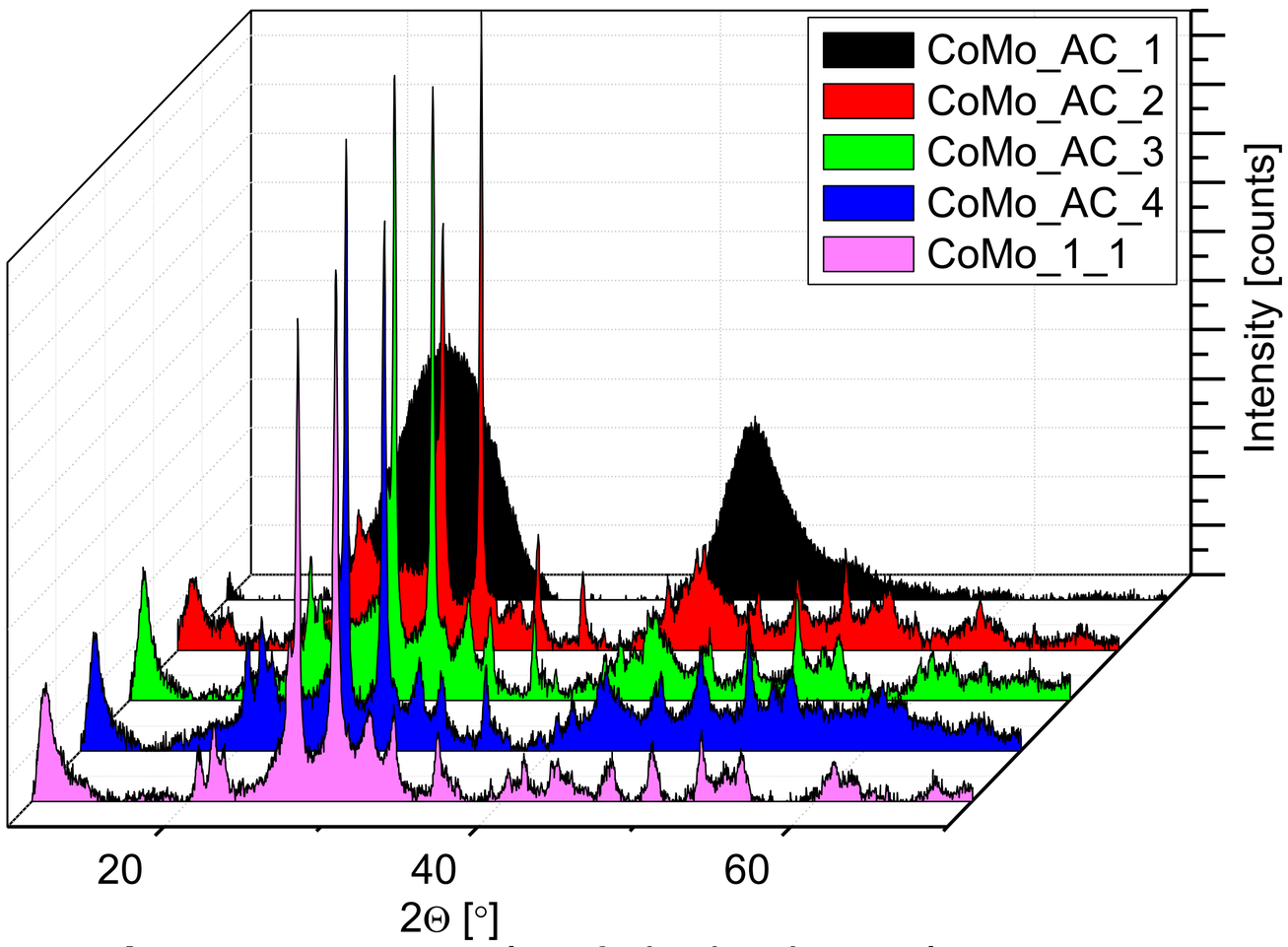

Figure 1. XRD results of obtained samples.

CONSLUSIONS

XRD (Fig.1) confirmed that presented preparation was succesful and cobalt molybdate was deposited on the AC. Moreover, sample with the lowest load indicated no sharp reflections, thus it might be assumed that very good dispersion was obtained.

Furthermore, nitrogen analysis (Table 1) confirmed that specific surface area decreases with increasing load. Similar trend is observed for total and micropore volumes. On the other hand, mesopore volume does not change. Possible explaination might be that catalyst precursor precipates preferentially in micropores.

References

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