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Co-Mn MIXED OXIDE CATALYSTS SUPPORTED ON STAINLESS STEEL MESHES PREPARED BY HYDROTHERMAL METHOD

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The stainless-steel supported catalysts are flexible to be fit into any kind of reactor, while ensuring a low pressure drop and good heat transfer¹. Moreover, the deposition of thin film of active phase on metal meshes enables its high utilization in catalytic reaction due to low influence of internal diffusion of reactants and products.

Oxides of Co and Mn show high catalytic activity in various oxidation reactions. In this study, we prepared the Co-Mn mixed oxides supported on stainless steel meshes by simultaneous precipitation of Co and Mn nitrates in the presence of hydrolyzing urea under hydrothermal conditions, followed by heating at 500 °C in air. The supported Co-Mn mixed oxide catalysts with various Co:Mn molar ratios were examined by XRD, SEM, and H₂-TPR and tested in the gas-phase oxidation of ethanol. Pelletized commercial Co-Mn-Al mixed oxide catalyst (Astin 2-100, Czech Republic, Co:Mn:Al molar ratio of 4:1:1) was added to the set of examined catalysts for comparison.

Properties of the catalysts are summarized in Table 1. The ethanol oxidation proceeded fastest over the catalyst with Co:Mn molar ratio of 1:1. However, reaction rates calculated for 200 °C revealed the catalyst with Co:Mn molar ratio of 1:4 as the most active. In comparison to pelletized catalyst Astin 2-100, the temperature needed for 90 % conversion to CO₂ was by 100 °C lower. This finding documents higher oxidation activity of Mn components in mixed oxides in comparison with the Co ones. In contrast to Mn-containing catalysts on the meshes, both Astin 2-100 and cobalt oxide catalyst did not exhibit the formation of CO. TPR measurements (Fig. 1) confirmed different reducibility of Co-Mn mixed oxides in dependence on their composition.

Table 1 Characteristics of the catalysts.

Co:Mn molar ratio	Oxides content wt. %	TPR ^{2,3} mmol H ₂ /g	T ₅₀ Et °C	T ₉₀ CO ₂ °C	R ₂₀₀ ³ mmol Et/g.h
0:1	4.97	3.42	200	248	6.7
1:4	1.14	5.26	195	253	34.2
2:3	2.55	3.53	195	251	14.7
1:1	3.28	3.05	185	244	14.5
3:2	2.95	5.08	194	264	15.0
4:1	1.91	6.03	189	254	23.6
1:0	1.80	-	224	269	7.4
Astin 2-100	100	5.2	189	353	0.4

¹ Weight loss (related to the weight of deposited oxides) after 10 min treatment in ultrasonic bath; ² 25-500 °C, ³ per g of active phase

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References

¹ L. del Río L.; G. Marbán G., Appl. Catal. B **2014**, 150-151, 370-379.

Fig. 1. TPR profiles of the catalysts.

