Oxidized Corrugated Al Foils as Supports of Catalysts Containing Co Oxides for VOC Oxidation.

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OXIDIZED CORRUGATED Al FOILS AS SUPPORTS OF CATALYSTS CONTAINING Co OXIDES FOR VOC OXIDATION

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Volatile organic compounds (VOCs) in industrial gases represent a serious environmental problem, as some of them exhibit toxic, narcotic, or carcinogenic properties. Catalytic process is markedly energy saving compared to elimination of VOCs by thermal combustion. Oxides of transition metals are a cheaper alternative to the noble metal catalysts. Total oxidation of ethanol including the reaction intermediates is interesting and worth studying as ethanol is often used as a fuel for buses and cars (e.g., in Scandinavian countries and especially in South America). For that reason, preparation of Co oxide catalysts over corrugated Al monoliths was studied.

Monoliths made of corrugated Al foils (0.25 mm) were prepared by etching with HCl solution (4.64 M), then oxidized by HNO_3 (65%), dried and calcined at 500/4 h. Co sol was prepared according to Lin et al. [1]. Monoliths were impregnated by the Co sol for 10 min, then dried and calcined (500 °C/4 h). The catalysts were characterized by SEM, XRD, porous structure, TPR and NH_3-TPD. Ethanol oxidation was carried out with 10 ml volume of catalyst from 80 to 400 °C and the temperature ramp of 2 °C min^{-1}, at GHSV of 20 m^3 kg^{-1} h^{-1}, and the inlet ethanol concentration in air 1.2 g m^{-3} (equaled to 750 ppm). Temperatures T_{50EtOH} and T_{50VOC} (the temperatures, at which 50% of ethanol and 50% of all organic compounds conversion were achieved) were chosen as a measure of the catalyst activity. Selectivity in ethanol conversion was evaluated as the amount of formed acetaldehyde (ppm) in the examined temperature range. The main results are summarized in Table 1. It is seen that the monolithic catalyst with 25.2 wt. % of Co oxides (18.5 wt. % of Co) shows similar catalytic activity as the commercial calcined coprecipitated Co-Mn-Al hydrotalcite-like precursor having four times higher content of active components. Quantity of acetaldehyde (AcA) seems to decrease with increasing amount of active components. No CO formation was observed during ethanol oxidation.

Table 1
Activity of the catalysts in ethanol oxidation. GHSV= 20 m^3 kg^{-1} h^{-1}.

Impr. Steps	Co_3O_4, wt. %	T_{50EtOH}, °C	AcA*, ppm
1	5.4	214	65242
2	8.5	198	72405
3	17.6	193	63217
4	25.2	184	58088
ASTIN 2-100	62.3**	195	41824

*Total amount of the formed acetaldehyde,
**Co+Mn, molar ratio Co:Mn=4:1

References:

[1] Lin, Ch.; J.A. Ritter, J.A.; Popov, B.N. J. Electrochem. Soc. **1998**, 4097-4103.

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