The characteristics of modified layered aluminosilicates as catalysts for VOC oxidation

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Introduction

Volatile organic compounds, or VOCs are organic chemical compounds whose composition makes it possible for them to evaporate under normal indoor atmospheric conditions of temperature and pressure. Volatile organic compounds have very hazardous impact on environment and our health. For this reason it is important to remove VOC from polluted air.

Materials and Methods

The aim of this study was prepare and test new catalytic materials, obtained from bentonite and vermiculite, for VOCs oxidation. To carry out the catalytic tests ethanol was chosen. Bentonite and vermiculite were pillared by Al-polycations and modified with copper, silver or iron as a active material. The samples were characterized by physisorption of N_2 at 77 K (specific surface area and transmission electron microscopy (distribution of active material). Catalytic performance of the prepared materials was tested for ethanol oxidation.

As starting materials for the studied catalysts the following layered clays were used: ***bentonite*** (Riedel-de Haen) and ***vermiculite*** (Sigma-Aldrich).

Wet impregnation – from 5% solution of $AgNO_3$, $Fe(NO_3)_3 \cdot 9H_2O$, $Cu(NO_3)_2 \cdot 3H_2O$

Catalytic test

These experiments were carried out in a U-type reactor. The sample (mass=0.2 g) was held by plug of quartz wool. The total flow was 250ml/min to which corresponds a hour space velocity (GHSV) of 51675 h^{-1}.

The catalytic test was carried out under the following conditions: ethanol 1100 ppm, O_2 7%, rest Ar.

Results and Discussion

Investigated catalysts were characterized by the following methods:

- Specific surface area S_{BET}
- Transmission electron microscopy TEM

Generally, results received for bentonite samples were much better (35-156 m^2/g) than results for vermiculite samples (4-23 m^2/g).

On the basic of this results were selected samples for catalytic tests with ethanol – bentonite: B, BAg, BFe, BCu, PV, PVAl, PVAlFe, PVFe.

Among samples of bentonite definitely the best was BCu. However, later in research turned out that the result obtained for BCu is not reproducible because of not homogeneous catalyst. Very good result obtained also for BFe. The best catalytic activity bentonite samples revealed at 400°C. Even in the case of low activity, every samples (except B and BAl) had very good selectivity to CO_2.

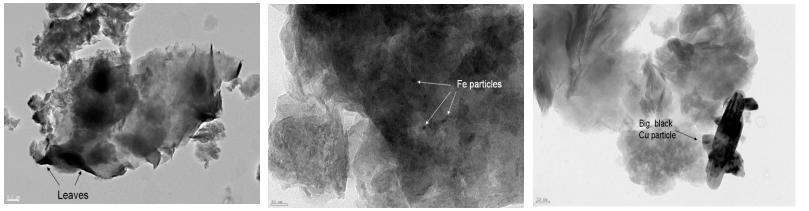

Figure 1. Pictures of bentonite obtained from TEM: left pure bentonite, middle: bentonite Fe, right: bentonite Cu

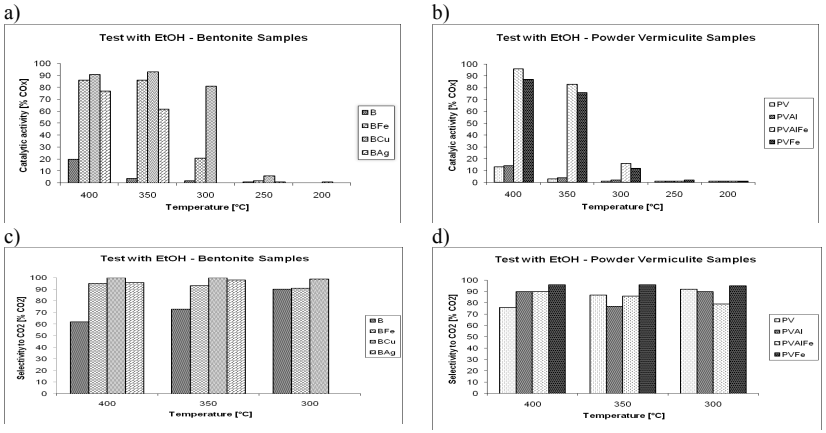

Figure 2. a. Catalytic activity for a) bentonite samples, b) vermiculite samples CO_x=CO+CO_2; Selectivity to CO_2 for: c) bentonite samples; d) vermiculite samples

Notable is that in all cases were obtained negligible amount of CO which bodes well this samples as catalyst for VOC oxidation.

References

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