Influence of preparation method of CuAl mixed oxide issued from LDH for LDH for catalytic total oxidation of VOC -CO

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Significance and Relevance

This work proves that it is possible to produce highly efficient catalysts issued from LDH precursors with low synthesis duration. Catalytic performance challenges the expensive noble metal-based systems for this this type of application. Moreover, the complexification of reaction mixture enhances the total oxidation of toluene indicating potential applications of this type of materials for the depollution of fumes issued from biomass combustion.

Topics: Air cleaning and combustion or Automotive and stationary emission control and Presentation preferred: *Oral only*

Introduction and Motivations

Emissions of VOCs into the environment is now strictly regulated due to harmful to public health and atmospheric environment and are often accompanied with CO in industrial and combustion fumes. In the aim to obtain a reaction economically competitive, it is necessary to explore higher active catalysts performing. Transition metal oxides, especially Co, Cu and Mn oxides, offer a low-cost alternative to metal noble based catalysts which are presently the most active catalysts in the complete oxidation of VOCs at low temperatures. An interesting way to obtain mixed oxides catalysts is through the use of layered double hydroxides (LDH) as precursors. The coprecipitation is the method widely applied for the LDH synthesis but recently, microwaves (MW) and ultrasound (US) have been applied as an alternative to the conventional treatments [1-3]. Several advantages such as shorter treatment times to achieve enhanced crystallinity degrees, higher specific surface areas, and increase the metallic dispersion are reported. In this study, CuAl LDH as precursors are characterized and investigated for total oxidation of CO and Toluene mixture.

Materials and Methods

LDH precursors Cu_6Al_2 were prepared by three methods (conventional synthesis (CT), MW treatment and US treatment) and calcined at 500°C before physicochemical characterizations. Catalytic tests were made using a gas mixture containing of 1000 ppm C_7H_8 and/or 1000ppm CO and air flow.

Results and Discussion

A beneficial effect of a MW and US method was observed on the preparation of mixed oxides. The characterization of these solids revealed several textural and physicochemical differences (specific surface areas, crystallites size, reducibility, …). The use of MW or US synthesis procedure was induced a variation of Cu/Al atomic ratio on the surface and O_{ads}/O_{bulk} observed by XPS analysis. Catalytic performances for toluene oxidation in presence or absence of CO according the T_{50} values shows an increase of activity for the solid prepared by US and MW. Relations between physicochemical properties and catalytic activity have been established (Figure 1), indicating a Mars Van Krevelen mechanism for toluene total oxidation in presence of CO in the reactional mixture.

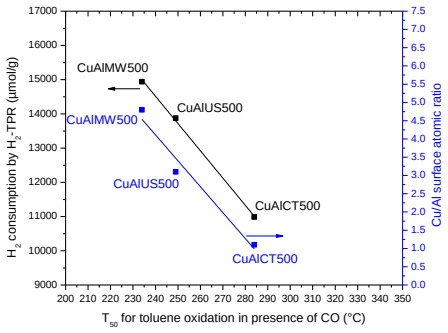

Figure 1 Relation between catalytic activity and physicochemical properties

References

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Acknowledgements

The authors gratefully acknowledge the financial support from the CPER-ECRIN program, the Hauts-de-France region and the European Community (Interreg Vi France-Wallonie-Vlaanderen project, "CleanAirBouw").