XAS study of ZnO-CuO-HPS catalyst

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Abstract

Methanol is a widely used chemical that can be applied to various reactions, moreover methanol can be used as an alternative fossil fuel [1]. Nowadays the synthesis of organic compounds, particularly methanol, from hydrogen and carbon oxides is a promising environmental friendly reaction that is conducted at both high pressure and temperature in the presence of catalysts [2]. The currently industrially established synthesis of methanol relies on Cu based catalysts providing high activity. However, the main drawback of that class of catalysts is their sensitivity to poisons, e.g. sulphur, halogens and nitrogen containing compounds, which are preferably present in bio resource feedstock. Thus the search for optimal reaction conditions as well as the development of new alternative catalytic systems and modifiers is of paramount importance.

Nowadays there are many analytical methods for catalyst structure investigations among them X-ray techniques are widely used. X-ray absorption spectroscopy (XAS) describes the electronic state of the active metals (XANES) as well as the size, shape and atomic arrangements of metal clusters (EXAFS) [3]. In this work we used XAS analysis to investigate the structure of the active sites of novel polymer-based ZnO-CuO catalyst showed good catalytic activity in CO hydrogenation to methanol.

It was shown that for initial catalyst both Cu and Zn exist in 2+ electronic states. The reduction treatment leads to the change of Cu electronic state to +1. It should be noted that after the reaction the electronic state of Cu does not change. The synthesized catalyst allows reaching methanol formation up to 2300 mg(Me)/(kg(cat)*h) under the chosen reaction conditions while methane formation decreases down to 60 mg(Methane)/(kg(cat)*h).