Structural evolution of ammonium paratungstate and ammonium heptamolybdate during thermal decomposition

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Mixed metal oxide systems (e. g. $Mo_x(V, W)_yO_{3-z}$) are employed for the partial oxidation of light alkenes [1]. Ammonium paratungstate (APT) and ammonium heptamolybdate (AHM) are used as precursors for the production of tungsten trioxide (WO_3) and molybdenum trioxide (MoO_3), respectively, and in mixtures for the synthesis of (Mo, W)-mixed metal oxides. The catalytic activity of these materials may depend on their structure; which in turn depends on the treatment of the precursors. Previously, we have studied the decomposition of AHM by in situ X-ray diffraction (XRD) and in situ X-ray absorption spectroscopy (XAS) [2]. Here, we present results obtained from bulk structural studies on the thermal decomposition of APT and mechanical mixture of APT and AHM. Temperature programmed decomposition was performed at temperatures between 20 - 500°C in various atmospheres (helium, 5 % hydrogen in He, 20 % oxygen in He, 10 % propene in He, and 10 % propene and 10 % oxygen in He).

Evidently, the phases formed during decomposition of APT dependent on the atmosphere employed. The decomposition of APT in propene, and propene and oxygen results in mostly WO_3 (XAS) together with minor amounts of different tungsten bronzes (XRD). The decomposition in hydrogen results in reduced tungsten oxides and, eventually, in the complete reduction of the intermediate tungsten oxides to W metal (XRD). During the decomposition of APT in propene and propene and oxygen, no oxidation products of propene were detected in the gas phase. Reduction of WO_3 to W metal takes place during the decomposition of APT in hydrogen, whereas no reduction of the resulting WO_3 is detected in propene and in propene and oxygen. This is in contrast to the reactivity of MoO_3 in the same temperature range, where the onset of reduction and catalytic activity at ~ 350 °C is correlated to the onset of the mobility of lattice oxygen.

References

[1] *Grzybowska-Swierkosz, B., Topics in Catalysis 11/12, 23 (2000)*
[2] *Wienold, J., Jentoft, R.E., Ressler T., Eur. J. Inorg. Chem., accepted*.

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