$FeVO_4$, $CeVO_4$ and $ErVO_4$-based catalysts for the selective catalytic reduction of NO with NH_3

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Efficient removal of NO_x from exhaust gases of stationary sources is realized by reacting it with NH_3 on a solid catalyst according to the standard selective catalytic reduction (SCR). Metal vanadate-based SCR catalysts exhibit promising advantages over traditional vanadia-based catalysts. Some $MeVO_4$ were shown to be resistant to deactivation when supported on SiO_2-WO_3-TiO_2 (TWS) and remained active after aging up to 750°C [1]. Nevertheless, it was recently shown that supported $FeVO_4$ is not stable on TWS and decomposes into Fe_2O_3 and VO_x species above 600°C [2, 3]. The intrinsic activity of the $FeVO_4$-based SCR catalysts is rather low and is only enhanced by the thermal decomposition. In order to clarify the benefits of vanadates as SCR catalysts, we compared the activity and stability of $FeVO_4$, $CeVO_4$ and $ErVO_4$ on a TWS support.

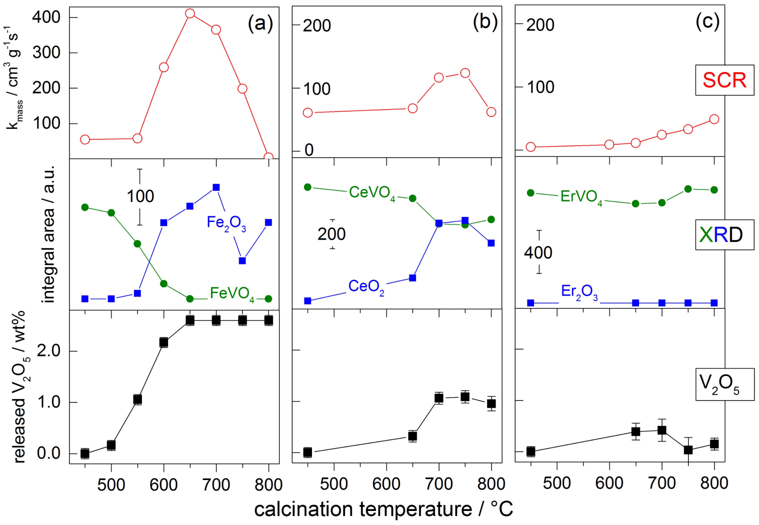

Figure 1. Top panels - rate constants, middle panels - important changes of XRD features; lower panels - derived fraction of released V_2O_5 of (a) $FeVO_4$-TWS, (b) $CeVO_4$-TWS and (c) $ErVO_4$-TWS.

It was shown that an increase of calcination temperature activates all catalysts (increase in rate constant k_{mass}, Figure 1) concurrent with the decrease of the metal vanadate peak integral from XRD. The decomposition of the metal vanadate gave rise to the corresponding metal oxides, but no traces of a new vanadium containing phase were observed. However, an estimation of released V_2O_5 could be derived from the loss of the metal vanadate phase (lower panels in Figure 1). The change of released V_2O_5 and k_{mass} are strongly correlated. While $FeVO_4$ decomposed completely, the maximum fraction of released V_2O_5 was 1.1 wt% for $CeVO_4$-TWS and 0.4 wt% for $ErVO_4$-TWS, hence $CeVO_4$ and $ErVO_4$ decomposed only partially. References with 0.5 and 1.0 wt% V_2O_5 on TWS showed very similar activity, indicating that the amount of released V_2O_5 is in fact responsible for the increase in activity. The existence of released V species from metal vanadates was proven using DRIFTS and DRUV, which revealed the predominant formation of extended VO_x units on the surface of TWS. Summarizing, metal vanadate catalysts supported on TWS become active only after their decomposition into metal oxides and free VO_x species.

[1] Casanova M., Schermanz K., Llorca J., Trovarelli A. *Catal. Today*, **2011** 184, 227
[2] Marberger A., M. Elsener M., Ferri D., Sagar A., Schermanz K., Kröcher O. *ACS Catal.* **2015**, 5, 4180 [3] Casanova M., Nodari L., Sagar A., Schermanz K., Trovarelli A. *Appl. Catal. B.* **2015***,* 176, 699