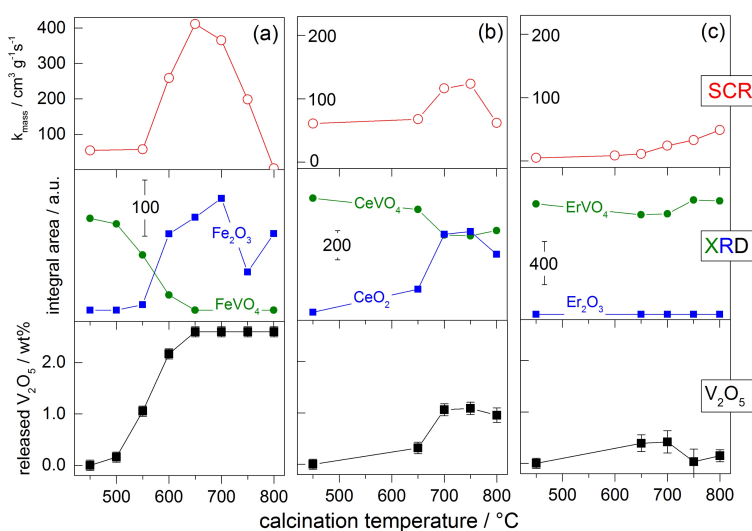


## FeVO<sub>4</sub>, CeVO<sub>4</sub> and ErVO<sub>4</sub>-based catalysts for the selective catalytic reduction of NO with NH<sub>3</sub>

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Efficient removal of NO<sub>x</sub> from exhaust gases of stationary sources is realized by reacting it with NH<sub>3</sub> 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<sub>4</sub> were shown to be resistant to deactivation when supported on SiO<sub>2</sub>-WO<sub>3</sub>-TiO<sub>2</sub> (TWS) and remained active after aging up to 750°C [1]. Nevertheless, it was recently shown that supported FeVO<sub>4</sub> is not stable on TWS and decomposes into Fe<sub>2</sub>O<sub>3</sub> and VO<sub>x</sub> species above 600°C [2, 3]. The intrinsic activity of the FeVO<sub>4</sub>-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<sub>4</sub>, CeVO<sub>4</sub> and ErVO<sub>4</sub> on a TWS support.



**Figure 1.** Top panels - rate constants, middle panels - important changes of XRD features; lower panels - derived fraction of released V<sub>2</sub>O<sub>5</sub> of (a) FeVO<sub>4</sub>-TWS, (b) CeVO<sub>4</sub>-TWS and (c) ErVO<sub>4</sub>-TWS.

It was shown that an increase of calcination temperature activates all catalysts (increase in rate constant  $k_{\text{mass}}$ , 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<sub>2</sub>O<sub>5</sub> could be derived from the loss of the metal vanadate phase (lower panels in Figure 1). The change of released V<sub>2</sub>O<sub>5</sub> and  $k_{\text{mass}}$  are strongly correlated. While FeVO<sub>4</sub> decomposed completely, the maximum fraction of released V<sub>2</sub>O<sub>5</sub> was 1.1 wt% for CeVO<sub>4</sub>-TWS and 0.4 wt% for ErVO<sub>4</sub>-TWS, hence CeVO<sub>4</sub> and ErVO<sub>4</sub> decomposed only partially. References with 0.5 and 1.0 wt% V<sub>2</sub>O<sub>5</sub> on TWS showed very similar activity, indicating that the amount of released V<sub>2</sub>O<sub>5</sub> 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<sub>x</sub> 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<sub>x</sub> species.

[1] Casanova M., Scherzmann K., Llorca J., Trovarelli A. *Catal. Today*, **2011** 184, 227

[2] Marberger A., M. Elsener M., Ferri D., Sagar A., Scherzmann K., Kröcher O. *ACS Catal.* **2015**, 5, 4180 [3] Casanova M., Nodari L., Sagar A., Scherzmann K., Trovarelli A. *Appl. Catal. B.* **2015**, 176, 699