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Efficient, low-temperature reduction of NO using supported vanadium substituted -heteropolyacids

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PURPOSE OF THE ABSTRACT

Supported vanadium-substituted Keggin polyoxometalates (POMs) were applied as catalysts for the selective catalytic reduction of NO using NH3 as reductant (NH3-SCR). Interestingly, HPA-3 (H6PV3Mo9O40) was found to be the most active catalytic species, and TiO2 (anatase) the most promoting support for the SCR reaction in the temperature range 200-350 °C. Moreover, 10 wt.% HPA 3 loading was found to be optimum resulting in nearly complete NO conversion at 350 °C. Characterization by several techniques, including N2-physisorption, NH3-TPD, FTIR, XPS and TEM showed distinctive structural HPA-3 support interactions explaining the beneficial interplay between both parts for the SCR reaction. Furthermore, different catalytically active surface species were identified at various reaction temperatures and SCR conditions by in-situ EPR spectroscopy. The study introduces a novel type of heterogeneous supported vanadium-based NH3-SCR catalysts comprising redox-active POMs, which so far mainly have been applied for homogeneously catalyzed reactions.

FIGURES

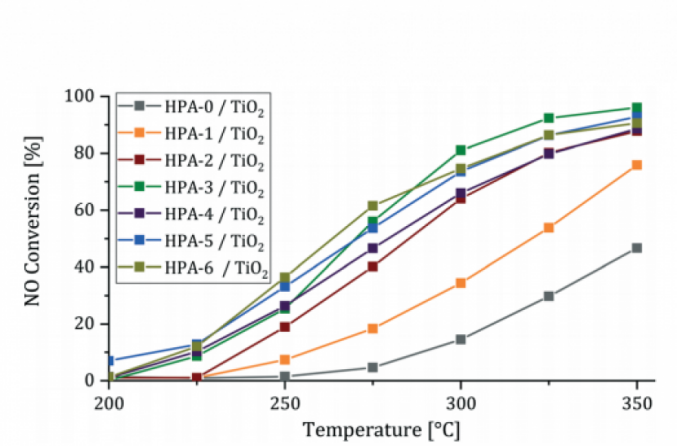

Fig. 1 NO conversion *versus* temperature for different HPA-*n*/TiO_2 (15 wt% HPA-*n* with *n* = 0–6) catalysts in NH_3-SCR. Reaction conditions: 50 mg catalyst (180–300 μm), 300 mg diluting agent (SiO_2), 1000 ppm NO, 1100 ppm NH_3, 4.5 vol% O_2, 2.3 vol% H_2O, F_{tot} = 512 ml min^{-1}, *T* = 200–350 °C.

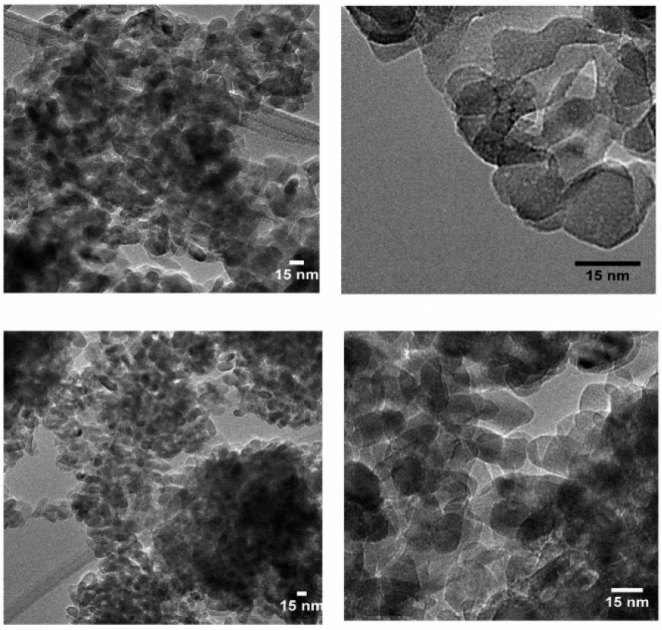

FIGURE 1

Figure 01

NO conversion vs. T for different HPA-n/TiO2 catalysts

FIGURE 2

Figure 02

TEM images of fresh and used HPA-3/TiO2 catalyst

KEYWORDS

NH3-SCR of NO | supported polyoxometalates | in-situ EPR spectroscopy | structural POM-support interactions

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