Divanadium Pentoxide Nanorods

N. Pinna*, K. Weiss, H. Sack-Kongehl, U. Wild, M. Willinger, J. Urban and R. Schlögl

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Divanadium pentoxide (V_2O_5) nanorods have been synthetized by reverse micelle technique[1]. The length can be tuned easily by keeping the nanorods in the micellar solution after the synthesis. The nanorods are characterized by transmission electron microscopy, x-ray photoemission spectroscopy, electron energy loss spectrometry, infrared spectroscopy and x-ray diffraction. These techniques show that the the nanorods are made of divanadium pentoxide and are crystallized in the γ phase.

Vanadium oxide, is a catalyst widely used in a variety of chemical reaction like partial oxydation or selective reduction of NO_x[2]. Vanadium oxide nanorods have been synthesized by colloidal self assembly made of Sodium bis(ethyl-2-hexyl)sulfosuccinate/Isooctane/H_2O[3].

The TEM pattern of fresh made divanadium pentoxide nanorods (Fig. 1 left) shows that the nanocrystals are characterized by an elongated shape: their average length is 47 nm and their width is 3 nm.

The nanorods are then kept in micellar solution for 24 hours and 4 days and then, like previously, deposited on a carbon grid. The TEM pattern (Fig. 1 center and right respectively) shows that the nanorods are growing in the micellar solution.

EELS spectra of γ-V_2O_5 nanorods (sample aged 24h) have been recorded and compared with ab initio calculations[4] (cf. Fig. 2 left). The vanadium edge is characterized by two peaks corresponding to the $V2p_{3/2}$ transition centered at 518.8 eV and the $V2p_{1/2}$ centered at 525 eV. As for bulk V_2O_5 the $V2p_{1/2}$ peak is more intense than the $V2p_{3/2}$. This is the signature that the oxidation state of the vanadium is +5. The $O1s$ peak centerd at 531.6 eV is dramatically different than in V_2O_5 bulk. So ab initio simulations are needed to understand this phenomenum.

HRTEM patterns and the power spectrum (Fig. 2 right) show that the nanorods are characterized by a good cristallinity.

In the present communication we demonstrate for the first time that V_2O_5 nanorods can be produced by the reverse micelle technique and that the size of these nanorods can be tuned easily by keeping the fresh made nanorods in the micellar solution.

Further studies of these divanadium pentoxide nanorods will focus on the catalytic activity in the oxidation of alkanes.

*Corresponding author, *e-mail: pinna@fhi-berlin.mpg.de*

Fritz-Haber-Institut der MPG, Abt. AC, Faradayweg 4-6, D-14195, Berlin

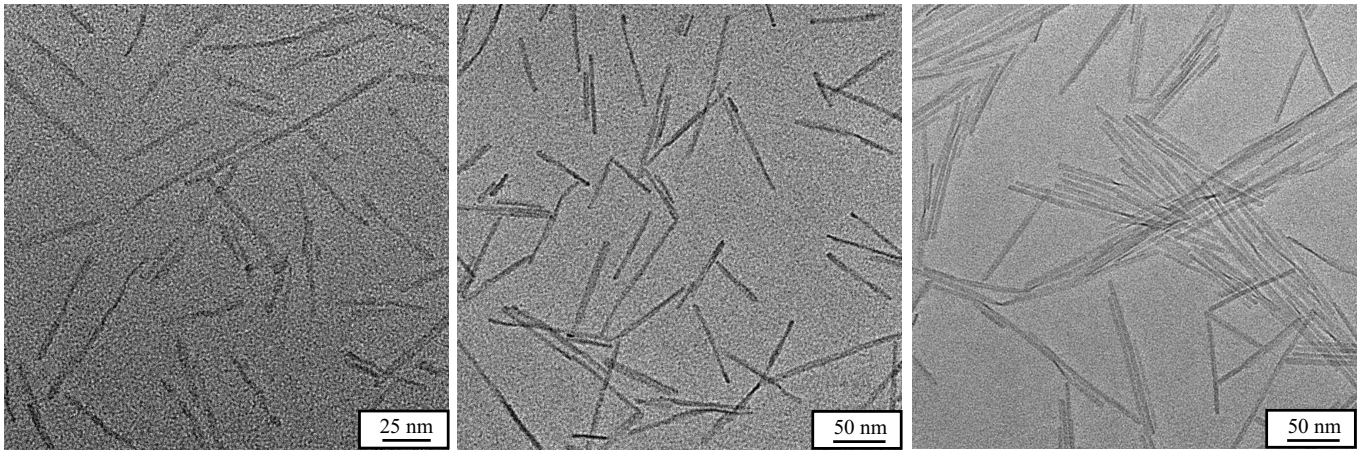

Figure 1: Vanadium oxide nanorods synthetized in reverse micelles. Just after synthesis (left), after 24h in micellar solution (center) and after 4 days in micellar solution (right)

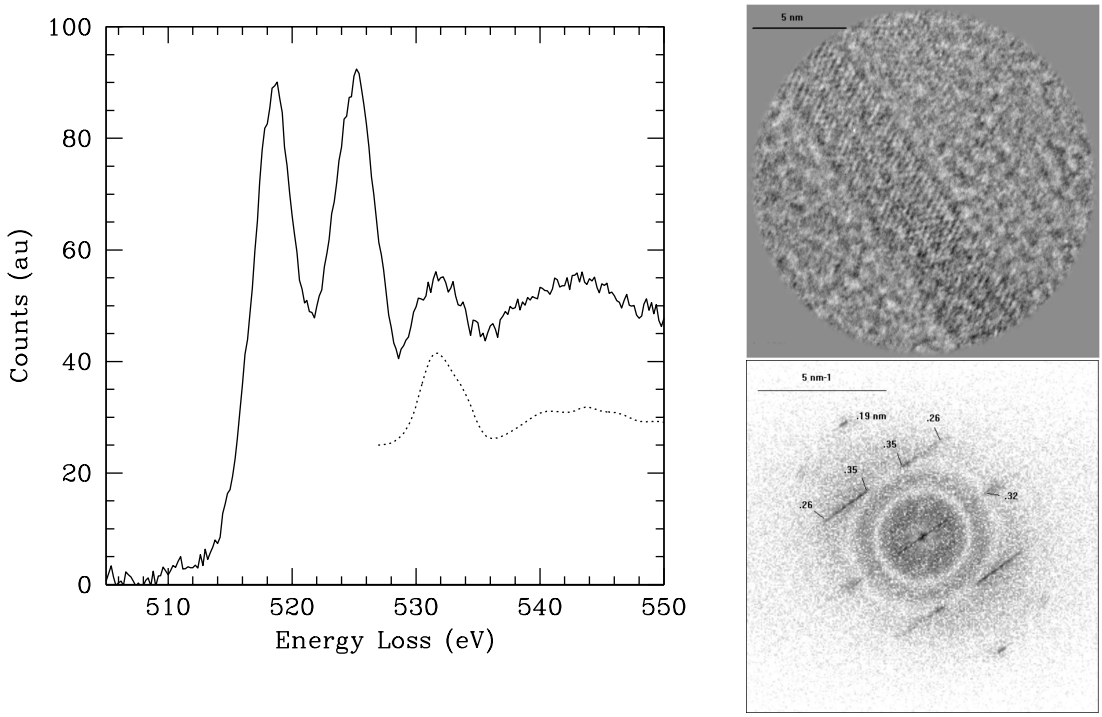

Figure 2: EELS spectra of the sample aged for 24h for the Vanadium 2p, the Oxygen 1s and calculations of the O1s edge (left), high resolution electronic microscopy and power spectrum (right) of a divanadium pentoxide nanorod

References

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