# Synthesis, size control and characterization of divanadium pentoxide nanorods

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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 oxidation state of the vanadium is 5+ and the nanorods are made of divanadium pentoxide.**

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/$H_2O$[1].
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 measurements has been performed under a transmission electron microscopy for the sample aged 24h (cf. Fig. 2 left). The first two features marked as $VL_3$ and $VL_2$ edges are attributed to the excitations from $V2p_{3/2}$ and $V2p_{1/2}$ core levels to the unoccupied $V3d$ states, respectively. The third peak, marked by $OK$, is due to the excitation of $O1s$ electrons[3]. The fact that $VL_2$ peak is more intense than $VL_3$ is caracteristic of $V_2O_5$[3].
HRTEM patterns and the power spectra (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.

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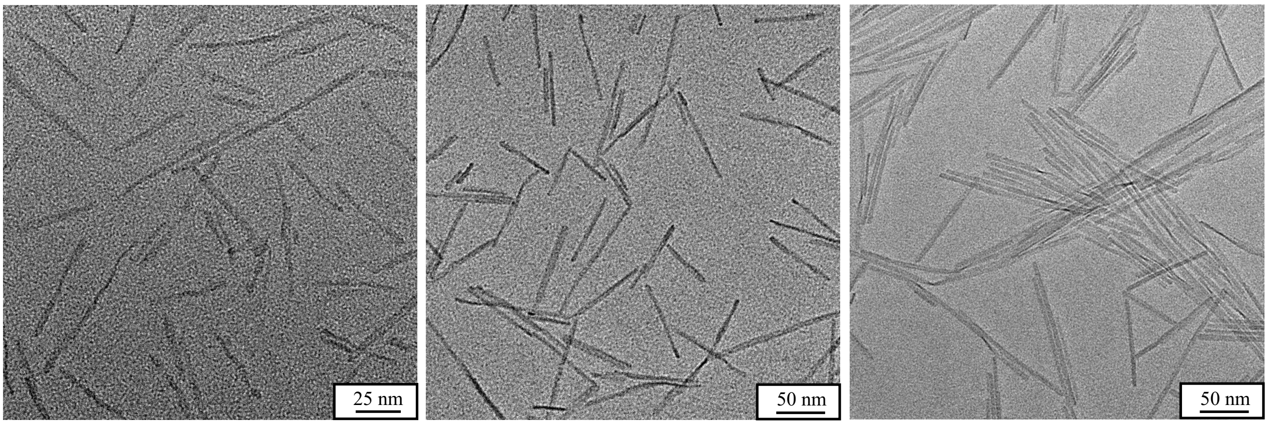


Figure 1: Vanadium oxide nanorods synthetized in reverse micelles. Just after synthesis (left), after 24h in micellar solution (center) and after 4 days in micellar solution (right)

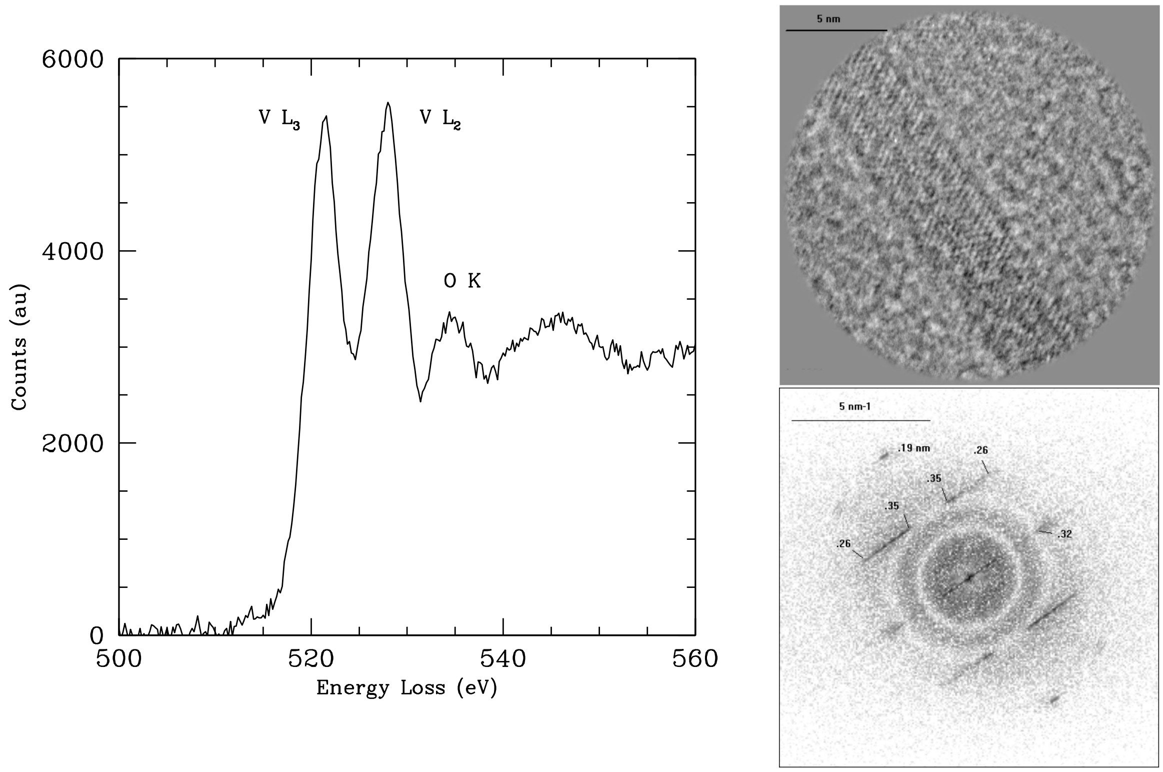


Figure 2: EELS spectra of the sample aged for 24h for the Vanadium 2p and the Oxygen 1s (left), high resolution electronic microscopy and powers pectra (right) of a divanadium pentoxide nanorod

# References

[1] M. P. Pileni, *Langmuir, **1997**, 13, 3266*

[2] *Handbook of heterogeneous catalysis*, Vol 4, edited by G. Ertl, H. Knözinger and J. Weitkamp (Wiley-VCH, Weinheim, 1997)

[3] D. S. Su, M. Wieske, E. Beckmann, A. Blume, G. Mestl, R. Schlögl, *Catalysis Letters **75**, 81 (2001)*