

Comparison of ELNES and NEXAFS of vanadium oxide V_2O_5 with different spectral resolution

D.S. Su*, M. Hävecker*, A. Knop-Gericke*, R. Mayer*, C. Hebert**, R. Schlögl*

*Department of Inorganic Chemistry, Fritz Haber Institute of the Max Planck Society, Faradayweg 4-6, D-14195 Berlin, Germany

**Institut für Angewandte und Technische Physik, Technische Universität Wien, Wiedner Hauptstraße 8-10, A-1040 Wien, Austria

Electron energy-loss spectrometer (EELS) on a transmission electron microscope (TEM) exhibit the advantages of high lateral resolution and on-line structure determination by the facilities of electron diffraction and high-resolution imaging. However, EELS usually suffers under the bad energy-resolution (ca.1 eV on TEM with field emission gun). Recently, many efforts have been made to increase the energy resolution; the most promising way is the development of a monochromator selecting electrons with monoenergy. In the present work, we give a comparison of ELNES (energy-loss near edge structure), measured with an energy resolution of 1 eV, with NEXAFS (near edge X-ray absorption fine structure), extracted from X-ray absorption spectrum (XAS) with an energy-resolution of 0.08 eV.

The EELS measurements were performed on a Philip CM 200 FEG TEM using the GATAN GIF 100 imaging filter, recorded in diffraction mode with a collection angle of 3.5 *mrad*. V_2O_5 single crystals were used. Spectra were recorded with the electron beam parallel to the c-axis (perpendicular to the layer plan). XAS experiments were carried out at the undulator beam line UE/56-2 PGM-1 at the third generation synchrotron radiation facility BESSY in Berlin [1]. The data were collected in the total electron yield mode under vacuum conditions. V_2O_5 single crystal was fixed on an alumina sample holder by a double adhesive conductive tape.

Fig. 1 shows the ELNES and NEXAFS of V_2O_5 , characterised by the V *L*-edges at above 519 and 526 eV, and the O *K*-edge at above 530 eV. Due to the high energy-resolution, the more detailed spectral feature in V *L*₃ NEXAFS become evident, and a drastic increase of the t_{2g}^* peak at the O *K*-edge is visible. The t_{2g}^* and e_g^* splitting is clearly better resolved in NEXAFS than in ELNES. Fig. 2 shows in an enlarged diagram of the V *L*₃ edge fine structures measured with 1 eV and 0.08 eV resolution. While the upper spectrum shows only a slight shoulder at 516.5 eV, the lower spectrum can be decomposed into 6 resonances. Empirically, a linear relationship between the 6 resonances and the V-O bond length in the VO_6 octahedron was established [2]. Theoretical interpretation of V *L*₃ and O *K* fine structure, which now becomes possible due to the high energy resolution, will be discussed using the band-structure calculations.

Acknowledgement

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Reference

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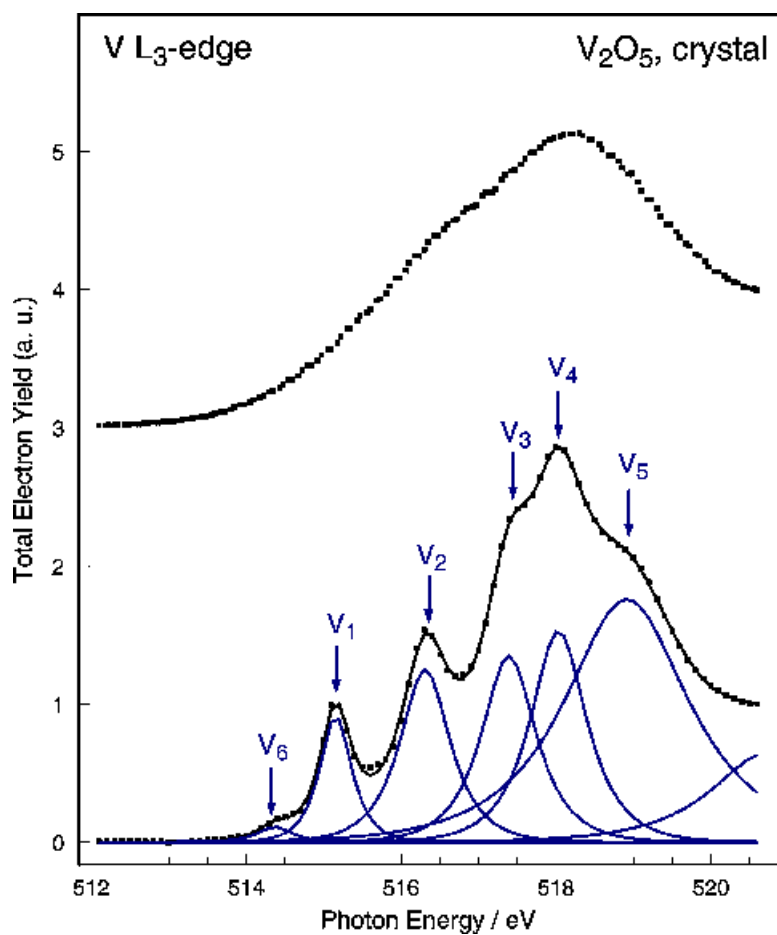
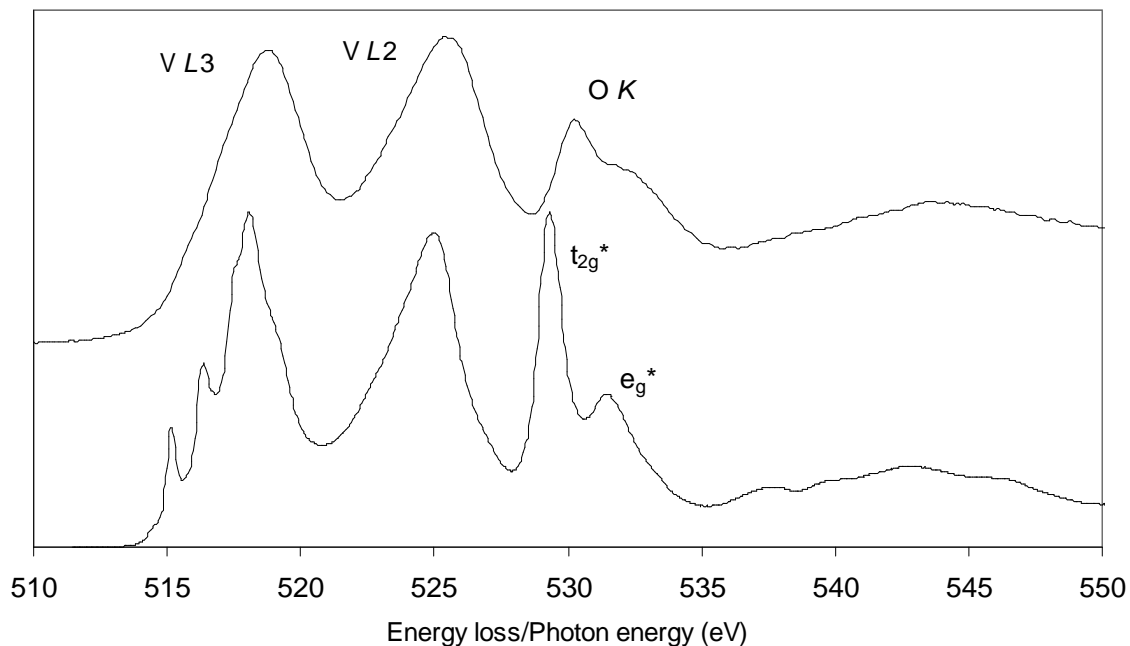


Fig. 1 (upper) ELNES and NEXAFS of V_2O_5 with an energy resolution of 1 and 0.08 eV respectively.

Fig. 2 (left) V L_{3} -edge of V_2O_5 measured with an energy resolution of 1 eV (upper) and 0.08 eV (lower), respectively. 6 resonances are obtained by deconvolution of the lower spectrum.