Layered metal phosphonates: a Resonant Inelastic X- ray Emission study at the transition metal L- edge.

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Transition metal organo-phosphonates are interesting solids for catalysis, ion-exchange and as intercaled compounds.

In these compounds the metal atoms form the central two dimensional layer and are bridged by oxygen atoms on either side to organic phosphonate groups.

In case of octahedral structure, (which is the most common for the first transition series) the phosphonate groups occupy five of the six metal coordination sites, the sixth being usually occupied by a water molecule. This can be thermally removed to create vacant sites for intercalation coordination.

This structure also provides the basis for cooperative magnetic interactions at low temperatures when the transition metal ions with unpaired spins are present in the lattice.

Purpose of this measurement was to study the electronic structure of the 3d transition metal atoms which constitute the central layer of the compound.

Central to our interest is the ‘d character effect in chemical binding’ which we hope is present in the valence band electronic structure as obtained by L edge X-ray emission spectra. In particular we want to take advantage of the resonant enhancement effect made possible by using tunable synchrotron radiation in coincidence with selected points in the transition metal X-ray absorption spectra (XAS).

The benefits of using L-edge transitions (and, as a consequence, vacuum ultraviolet excitation energy ranges) in TM compounds studies and in particular the XES sensitivity to the ligand environment have been reported in literature [1, 2, 3].

We have measured and studied a new series of magnetic Cr(II) and Fe(II) organo phosphonates which show different magnetic as well structural properties. The samples are $Cr(CH_3PO_3)H_2O$ and $Fe(O_3P\text{-}CH_2\text{-}PO_3)2H_2O$. The structural properties have been previously analyzed by X-ray diffraction methods.

Samples of $Cr(CH_3PO_3)H_2O$ obtained by different preparation techniques show different XRD spectra as well as magnetic behavior.

Resonant enhancement in the Raman scattering region shows a double peak feature which changes as the spectra evolve into normal fluorescence for energy values above the absorption edge.

The feature is being studied, compared to theoretical calculations and a tentative assignment done in terms of the compounds magnetic properties.

REFERENCES

[1] C.T. Chen; F. Sette. Physica Scripta T31, 119 (1990)
[2] M.M.Grush, Y. Muramatsu, J.H. Underwood, E.M. Gulikson, D.L. Ederer, R.C.C.Perera, T.A.Callcott; J. Electr. Spectr. Rel. Phen. 92, 225 (1998)
[3] S. Plogmann, T. Schlathoelter, J. Braun, M.Neumann, Y.M.Yarmoshenko, M.V. Yablonskikh, E.I. Shreder, E.Z. Kurmaev, A Wrona, A.Slebarski. Phys. Rev. B 60, 6428 (1999)

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