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Application of a Difference Electron Nanoscope (DEN): Correlation between 3D magnetical structures of synthetic fayalite with synchrotron and neutron diffraction and Mossbauer spectroscopy

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The evaluation of a 3-dimensional orientation of magnetic moments in solids is still a challenging problem in modern solid state physics and crystallography. Common methods to arrive at this goal are neutron diffraction, magnetometry and Single Crystal Mossbauer Spectroscopy (SCMBS). However, each of these methods have their limitations, viz. antiphase domains, magnetical impurities a.s.o. X-ray and synchrotron diffraction may provide valuable insights in cryystallographic structures, but the separation of the magnetically effective 3d electrons is hardly possible with the latter methods.By the recently presented Difference Electron Nanoscope (DEN) - a sophisticated program system in connection with a powerful computer - we dispose of a tool to display the 3-dimensional distribution of very accurately determined difference electrons from synchrotron diffraction measurements and to correlate them to the size and direction of the electric field gradient (efg) from DFT calculations and Mossbauer spectroscopy. Since the latter is also capable of deriving the size and direction of the internal magnetic field H(0) with respect to the efg, we can now correlate the above mentioned difference electron distribution with H(0) and the magnetic moments' orientation from neutron diffraction.On the DEN images amazing details can be seen, viz. difference electrons within the unit cell on a sub-nanometer scale around those special oxygens that have been identified as being candidates for superexchange coupling.

Biography

Werner Lottermoser has completed his thesis work about neutron diffraction and magnetism of special silicates from Francfort University (Germany) and university lecturing qualification on Single Crystal Mossbauer Spectroscopy (SCMBS) in 1996 from Salzburg University (Austria). He is now working on sub-nanometric imaging, nanomaterials and materials for industrial applications. He has published more than 65 papers in reputed journals and 150 abstracts and has been serving e.g. for one year as a referee board member at the Journal of Physical Chemistry A.

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