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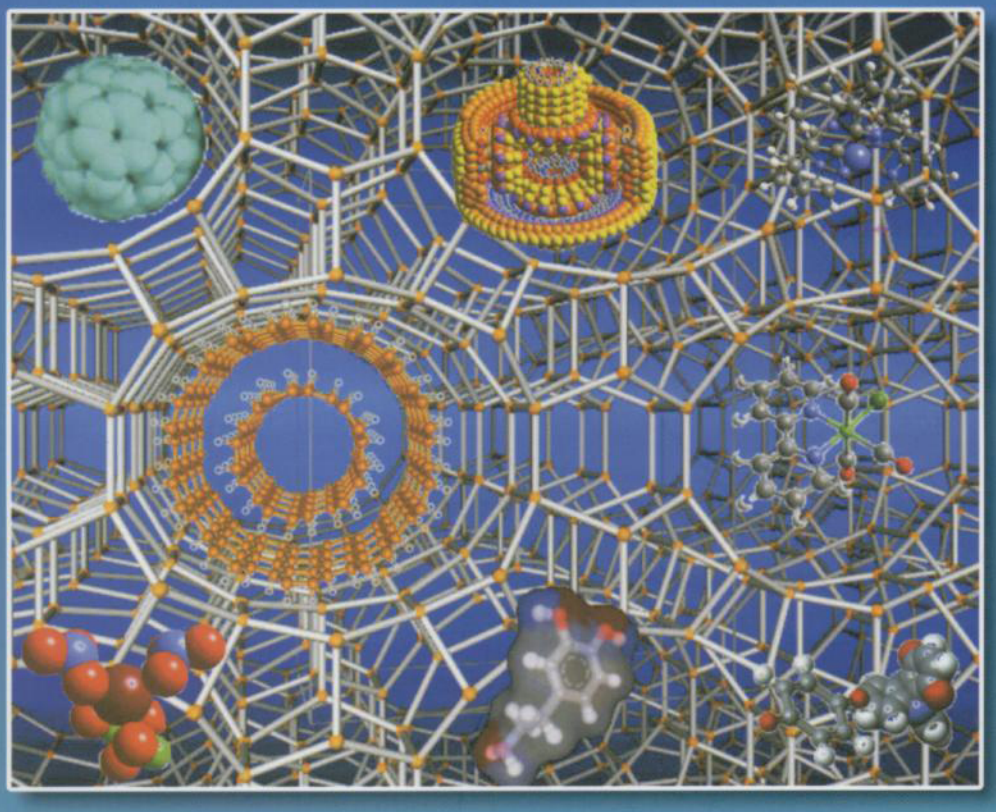

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Mössbauer studies of geometrical frustration spinel $ZnCr_{1.98}{}^{57}Fe_{0.02}O_4$

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In order to elucidate the role of Cr ions in $ZnCr_2O_4$ exhibiting geometrically frustration[1, 2], we have substituted a small amount of Fe ions for Cr sites and investigated the magnetic behavior of Fe ions, on nano scale, using Mössbauer measurement. The spinel $ZnCr_{1.98}{}^{57}Fe_{0.02}O_4$ powders were prepared by wet chemical solution process. Weighted amounts of zinc nitrate, chrome nitrate, and ^{57}Fe isotope were dissolved in acetic acid, ethanol, nitric acid, and distilled water. The solution was refluxed at 80 °C for 12 hours to allow the gel formation and then dried at 120 °C in a dry oven for 24 hours. The dried powder was ground and annealed at 1000 °C for 3 hours in air. The crystal structure was found to be single-phase cubic spinel with space group of *Fd3m*. The lattice constant a_0 and the internal structural parameter (x) of the oxygen were determined to be 8.331 Å and 0.260, respectively. Mössbauer spectra of $ZnCr_{1.98}{}^{57}Fe_{0.02}O_4$ were taken from 4.2 to 295 K using a ^{57}Co source in a rhodium matrix. At room temperature paramagnetic doublet is observed. Isomer shift values (δ) of doublet is found to be 0.23 mm/s relative to the Fe metal. , which are consistent with the high spin Fe^{3+} charge state.

The absorption spectra at 4.2K show that the well developed two sextets are superposed with small difference of hyperfine field ($H_{hf}1$= 463 and $H_{hf}2$= 453 kOe). Isomer shift values (δ) of the two sextets are found to be 0.33 and 0.34 mm/s relative to the Fe metal, respectively, which are consistent with the high spin Fe^{3+} charge state.

References

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2. Hiroaki Ueda, Hiroko Aruga Katori, Hiroyuki Mitamura, Tsuneaki Goto, and Hidenori Takagi, Phys. Rev. Lett., **94**, 047202 (2005)