

Copper valence, structural separation and lattice dynamics in tennantite (fahlore): NMR, NQR and SQUID studies

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Abstract

Electronic and magnetic properties of tennantite subfamily of tetrahedrite-group minerals have been studied by copper nuclear quadrupole resonance (NQR), nuclear magnetic resonance (NMR) and SQUID magnetometry methods. The temperature dependences of copper NQR frequencies and line-width, nuclear spin-lattice relaxation rate T_1^{-1} and nuclear spin-echo decay rate T_2^{-1} in tennantite samples in the temperature range 4.2-210 K is evidence of the presence of field fluctuations caused by electronic spins hopping between copper CuS_3 positions via S_2 bridging atom. The analysis of copper NQR data at low temperatures points to the magnetic phase transition near 65 K. The magnetic susceptibility in the range 2-300 K shows a Curie-Weiss behavior, which is mainly determined by Fe^{2+} paramagnetic substituting ions. © Springer-Verlag 2007.

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Keywords

Magnetic phase transition, NMR, NQR, SQUID, Tennantite, Tetrahedrite