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MAGNETIC ORDERING IN THE QUASI-1D COMPOUND $Cu_2Fe_2Ge_4O_{13}$ AS MONITORED BY ^{57}Fe MÖSSBAUER SPECTROSCOPY AND SQUID MAGNETOMETRY

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The germanate compound $Cu_2Fe_2Ge_4O_{13}$ has been synthesized by solid state ceramic sintering techniques between 1173 K and 1423 K. The structure is isotypic with $Cu_2Sc_2Ge_4O_{13}$, described recently by REDHAMMER & ROTH (2004). The title compound is monoclinic, space group $P2_1/m$, $Z = 4$, $a = 12.134(2)$ Å, $b = 8.5153(9)$ Å, $c = 4.8795(8)$ Å, $\beta = 96.10(2)°$. The structure consists of crankshaft-like chains of edge -sharing FeO_6 octahedra running parallel to the crystallographic b - axis. These chains are linked laterally by $[Cu_2O_6]^{6-}$ dimers forming a sheet of metal-oxygen-polyhedra within the a - b plane. These sheets are separated along the c - axis by $[Ge_4O_{13}]^{10-}$ clusters. Cooling to 15 K does not alter the crystallographic symmetry of $Cu_2Fe_2Ge_4O_{13}$. SQUID magnetometric measurements at an external field above 0.1 T show two events in $\chi(T)$, one at around 100 K, and one at 40 K. The first one is characterized by a broad maximum in the temperature dependence of the magnetic susceptibility χ, the second one by a change in slope. At low external magnetic fields (0.01 T), the second event is also visible as a clearly resolved peak. The question arises, which magnetic ordering phenomena can be assigned to these two events. In situ low-temperature ^{57}Fe Mössbauer spectroscopy has been used to get a deeper insight into these ordering processes. At room temperature, the spectrum consists of a single quadrupole doublet with a large quadrupole splitting. This doublet can be assigned to the strongly distorted CuO_6 octahedron. Cooling down to liquid nitrogen temperature does not alter the general appearances of the spectrum, i.e. no magnetic ordering can be detected. However, a distinct increase of the width of the resonance absorption lines is observable between 140 K and 100 K. Thus the 100 K maximum in $\chi(T)$ is assigned to low dimensional magnetic ordering within the Cu-dimers. At 40 K full magnetic 3-dimensional ordering takes place expressed by the appearance of a magnetically split ^{57}Fe Mössbauer spectrum.

References

REDHAMMER, G.J. & ROTH, G. (2004): J. Solid State Chem., in press.