# On the Crystal Distortion in Several Spinel Systems(Physics)

**On the Crystal Distortion in Several Spinel Systems**

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The composition and temperature dependence of cooperative Jahn-Teller distortions have been studied in the spinel mixtures $CuFe_{2-2x}Zn_xTi_xO_4$. $CuFe_{2-2x}Zn_xGe_xO_4$, and $CuFe_{2-2x}Ga_{2x}O_4$ which contain $Cu^{2+}$-ions in B-sites. In the former two cases the tetragonal distortion rapidly disappears with the substitution of a small amount of $Fe^{3+}$ by $Zn^{2+}Ti^{4+}$ or $Zn^{2+}Ge^{4+}$. Electrostatie potentials in these systems have been calculated from the measured values of the $u$-parameter and the cause of the non-distortion has been investigated on the basis of the intrinsic energy of the crystal. The effective Bohr magneton number of $Cu^{2+}$-ions of the spinel $CuFe_{0.8}Ga_{1.2}O_4$ deduced from the $1/\chi$-$T$ curve takes a value close to the calculated one corresponding to the "spin-only" state of $Cu^{2+}$ions even above the cubic-to-tetragonal transformation temperature.

**Antiferromagnetic Characteristics of Cr-Sn and Cr-Fe Alloys, and Non-ferromagnetic Cr-Fe-Sn Invar Alloys**

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Invar alloys are widely used as materials for precision instruments. The practical Invar alloys are all ferromagnetic, and the ferromagnetism of these alloys often limits the scope of their application.

In recent years, therefore, considerable attention has been directed to the research and development of nonferromagnetic Invar alloys.

Cr is an antiferromagnetic material and its physical properties such as thermal expansivity and electrical resistivity change anomalously near the Néel temperature. These properties are sensibly modified by the addition of other elements. The present authors investigated the temperature dependence of the physical properties for some Cr-base primary solid solution alloys.

With the addition of Sn, the Néel temperature of Cr increases up to 2.0%Sn and then decreases gradually, the thermal expansion coefficient below the Néel temperature becomes smaller. The Néel temperature in the Cr-Fe system decrease with increasing Fe concentration, while the thermal expansivity does not show any regular dependences on temperature and concentration.

Taking the above-mentioned results into consideration, the thermal expansivity and the magnetic susceptibility of the Cr-Fe-Sn alloys in the range of the primary solid solution have been measured.

The results show that the alloys are of the antiferromagnetic Invar type and their magnetic susceptibility is negligibly small.