# Site preference for $Zn^{2+}$ and $Ge^{4+}$ in mixed ferrite $Zn_xGe_{1-x}Fe_2O_4$

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Small amounts of $Zn^{2+}$ and $Ge^{4+}$ substituting for $GeFe_2O_4$ and $ZnFe_2O_4$, can efficiently increase the Neél temperature, thereby can be applied to magnetic device. The site preference of $Fe^{2+}$ and $Fe^{3+}$ in mixed ferrite $Zn_xGe_{1-x}Fe_2O_4$ ($X=0.6$) with Mössbauer absorption and x-ray diffraction was studied. Analysis of x-ray diffraction indicates that the lattice constant is not in accord with Vegard's law, suggesting $Fe^{2+}$ and $Fe^{3+}$ are located not only at $B$ sites but at $A$ sites. It is found that Debye temperatures of $GeFe_2O_4$ and $ZnFe_2O_4$ are $380\pm5$ K and $361\pm5$ K from Mössbauer measurements. $Zn^{2+}$ and $Ge^{4+}$ randomly occupy $A$ site or $B$ site. Mössbauer spectra of $Zn_{0.6}Ge_{0.4}Fe_2O_4$ reveal line broadening with increasing temperature and the relaxation effect at low temperature.