JOURNAL OF APPLIED PHYSICS **107**, 09E106 (2010)

# The geometrical frustration properties of the antiferromagnetic $Ni_{1-x}Fe_xGa_2S_4$ $(0.01 \leq x \leq 1)$

Bo Ra Myoung,[1] Sam Jin Kim,[1] Bo Wha Lee,[2] and Chul Sung Kim[1,a)]
[1]*Department of Physics, Kookmin University, Seoul 136-702, South Korea*
[2]*Department of Physics, Hankuk University of Foreign Studies, Yongin, Kyungki 449-791, South Korea*

(Presented 22 January 2010; received 31 October 2009; accepted 5 January 2010; published online 21 April 2010)

$Ni_{1-x}Fe_xGa_2S_4$ $(0.01 \leq x \leq 1)$ has been studied by x-ray, Mössbauer spectroscopy, and superconducting quantum-interference device (SQUID) magnetometer. The samples were prepared by a standard solid-state reaction method. The crystal has a trigonal structure with space group P-3m1. The lattice constants $a_0$, $c_0$ and bond length $d_{Fe-S}$ increase linearly with increasing Fe concentration. The Néel temperature ($T_N$) for $Ni_{1-x}Fe_xGa_2S_4$ $(0.01 \leq x \leq 1)$ increases with increase in Fe concentration, which is due to the short-range ordering in the undoped sample which changes into the long-range ordering with increase in Fe. The quadrupole splitting $\Delta E_Q$ increases with Fe substitution in Mössbauer spectra in $Ni_{1-x}Fe_xGa_2S_4$ $(0.01 \leq x \leq 1)$ at 4.2 K. We report that the spin configuration for geometrically frustrated $Ni_{1-x}Fe_xGa_2S_4$ $(0.01 \leq x \leq 1)$ at 4.2 K has fluctuating incommensurate state by Mössbauer spectra spectroscopy. 
[doi:10.1063/1.3364052]