ISSN (Print) 1226-1750
ISSN (Online) 2233-6656
Journal of Magnetics 19(2), 126-129 (2014)
http://dx.doi.org/10.4283/JMAG.2014.19.2.126

# Evidence of Spin Reorientation by Mössbauer Analysis

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(Received 21 February 2014, Received in final form 23 April 2014, Accepted 28 April 2014)

**We report the crystallographic and magnetic properties of $Ni_{0.3}Fe_{0.7}Ga_2S_4$ by means of X-ray diffractometer (XRD), a superconducting quantum interference device (SQUID) magnetometer, and a Mössbauer spectroscopy. In particular, $Ni_{0.3}Fe_{0.7}Ga_2S_4$ was studied by Mössbauer analysis for evidence of spin reorientation. The chalcogenide material $Ni_{0.3}Fe_{0.7}Ga_2S_4$ was fabricated by a direct reaction method. XRD analysis confirmed that $Ni_{0.3}Fe_{0.7}Ga_2S_4$ has a 2-dimension (2-D) triangular lattice structure, with space group *P-3m1*. The Mössbauer spectra of $Ni_{0.3}Fe_{0.7}Ga_2S_4$ at spectra at various temperatures from 4.2 to 300 K showed that the spectrum at 4.2 K has a severely distorted 8-line shape, as spin liquid. Electric quadrupole splitting, $E_Q$ has anomalous two-points of temperature dependence of $E_Q$ curve as freezing temperature, $T_f$ = 11 K, and Néel temperature, $T_N$ = 26 K. This suggests that there appears to be a slowly-fluctuating "spin gel" state between $T_f$ and $T_N$, caused by non-paramagnetic spin state below $T_N$. This comes from charge re-distribution due to spin-orientation above $T_f$, and $T_N$, due to the changing $E_Q$ at various temperatures. Isomer shift value (0.7 mm/s $\leq \delta \leq$ 0.9 mm/s) shows that the charge states are ferrous ($Fe^{2+}$), for all temperature range. The Debye temperature for the octahedral site was found to be $\Theta_D$ = 260 K.**

**Keywords :** mössbauer spectroscopy, spin reorientation, electric quadrupole splitting