

REFERENCES

A

Akthar, M. J.; Nadeem, M.; Javaid , S.; Atif, M. "Cation Distribution In Nanocrystalline ZnFe₂O₄ Investigated using X-ray Absorption Fine Structure Spectroscopy" *J. Phys.: Condens. Matter* **21** (2009) 405303.

Ali, M., Adie, P., Marrows, C. H., Greig, D., Hickey, B. J., Stamps, R. L., "Exchange bias using a spin glass" *Nature materials* **6** 70 (2007) 1809.

Ali, M., Marrows, C. H., Hickey, B. J., "Onset of exchange bias in ultrathin antiferromagnetic layers" *Phys. Rev. B* **67** (2003) 172405.

Almeida, J. R. L. de, Thouless, D. J., "Stability of the Sherrington-Kirkpatrick solution of a spin glass model" *J. Phys. A: Mag. Gen.*, **11** (1978) 5.

Aqeel, A; Vlietstra, N; Heuver, J. A.; Bauer, G. E.W.; Noheda, B.; van Wees, B. J.; Palstra, T. T. M., "Spin-Hall magnetoresistance and spin Seebeck effect in spin-spiral and paramagnetic phases of multiferroic CoCr₂O₄ films" *Physical Review B* **92** (2015) 224410.

Aquilanti, G.; Cognigni, A.; Anis-ur-Rehman, M., "Cation distribution in Zn doped cobalt nanoferrites determined by X-ray absorption spectroscopy" *Journal of superconductivity and novel magnetism* **24** (1-2) (2011) 659-663.

B

Baaziz, W., Pichon, B. P., Lefevre, C., Ulhaq-Bouillet, C., Grenache, J-M., Toumi, M., Mhiri, T., Begin-Colin S., "High exchange bias in Fe_{3-x}O₄@CoO core shell nanoparticles synthesized by a one-pot seed-mediated growth method" *J. Phys. Chem. C* **117** (2013) 11436-11443.

Barman, J., Bora, T., Ravi, S., "Study of exchange bias and training effect in NiCr₂O₄" *J. Magn. Magn. Mater.* **385** 2015 93-98.

Barrera, G., Coisson, M., Celegato,F., Raghuvanshi, S., Mazaleyrat, F., S N. Kane, P. Tiberto "Cation distribution effect on static and dynamic magnetic properties of Co_{1-x}Zn_xFe₂O₄ ferrite powders" *J. Magn. Magn. Mater.* **456** (2018)372-380.

Basu, S.; Nayak, C.; Yadav, A.; Agrawal, A.; Poswal, A.; Bhattacharyya, D.; Jha, S.; Sahoo, N. "In A comprehensive facility for EXAFS measurements at the INDUS-2 synchrotron source at RRCAT, Indore, India" *Journal of Physics: Conference Series, IOP Publishing*: 2014; p 012032.

Bayhan, M., Kavasoglu, N., "A study on the humidity sensing properties of ZnCr₂O₄-K₂CrO₄ ionic conductive ceramic sensor" *Sensors and Actuators B* **117** (1) (2006) 261-265.

Bean, C. P., "Hysteresis loops of mixtures of ferromagnetic micropowders" *J. App. Phys.* **26** (1955)1381.

Bedanta, S., Kleemann, W., *J. Phys. D: Appl. Phys.*, **42** (2009) 013001.

Benitez, M. J., Petracic, O., Salabas, E. L., Radu, F., Tuysuz, H., Schuth, F., Zabel, H., "Evidence for core-shell magnetic behavior in antiferromagnetic Co_3O_4 nanowires" *Phys. Rev. Lett.* **101** (2008) 097206.

Berkowithz A. E., Takano, K., "Exchange anisotropy- a review" *J. Magn. Magn. Mater.* **200** (1999) 552.

Bhowmik, R. N., Ranganathan, R., Nagarajan, R., "Lattice Expansion and Non-collinear to Collinear Ferrimagnetic Order in MnCr_2O_4 " *Phy. Rev. B* **73** (2006) 144413.

Binder, K.; Young, A. P., "Spin glasses: Experimental facts, theoretical concepts, and open questions" *Reviews of Modern physics*, **58** (4) (1986) 801.

Binek, C., "Training of the exchange-bias effect: A simple analytic approach" *Phys. Rev. B* **70** (1999) 014421.

Bisht, V., Rajeev, K. P., "Memory and aging effects in NiO nanoparticles" *J. Phys.: Condens. Matter* **22** (2010) 016003.

Biswas, S., Sabyasachi, S. K., Bhaumik, A., Ruma Ray "Magnetic memory effects in $\text{Fe}/\gamma\text{-Fe}_2\text{O}_3$ nanostructures" *IEEE Trans. Magn.* **Vol. 50** No. 3 (2014) 2301107.

Bitoh, T., Ohba, K., Takamatsu, M., Shirane, T., Chikazawa, S., "Field-Cooled and Zero-Field-Cooled Magnetization of Superparamagnetic Fine Particles in $\text{Cu}_{97}\text{Co}_3$ Alloy: Comparison with Spin-Glass $\text{Au}_{96}\text{Fe}_4$ Alloy" *J. Phys. Soc. Jpn.* **64** (1995) 1305

Bush, A. A., Shkuratov, V. Y., Kamentsev, K. E., Prokhorov, A. S., Zhukova, E. S., Gorshunov, B. P., Torgashev, V. I. "Ferroelectricity in spinel solid solution $\text{Co}_{0.8}\text{Ni}_{0.2}\text{Cr}_2\text{O}_4$ " *Phys. Rev. B* **85** (2012) 214112.

C

Cador, O., Grasset, F., Haneda, H., Etourneau, J., " Memory effect and super-spin-glass ordering in an aggregated nanoparticle sample" *J. Magn. Magn. Mater.* **268** (2004) 232-236.

Calleja, F. B.; Fakirov, S., "Microhardness of polymers" *Cambridge University Press*: 2007.

Camilla, N.; Astrid, L. R.; David, G. N., "Nanophase Cobalt, Nickel and Zinc Ferrites: Synchrotron XAS Study on the Crystallite Size Dependence of Metal Distribution" *Phys. Chem. Chem. Phys.* **10** (2008) 1053-1066.

Chandra, S., Khurshid, H., Li, W., Hadjipanayis, G. C., Phan, M. H., Srikanth, H., " Spin dynamics and criteria for onset of exchange bias in superspin glass $\text{Fe}/\gamma\text{-Fe}_2\text{O}_3$ core-shell nanoparticles" *Phys. Rev. B* **86** (2012) 014426.

Chang, L. J., Huang, D. J., Li, W-H., Cheong, S-W., Ratcliff, W., Lynn, J. W., “Crossover from incommensurate to commensurate magnetic ordering in CoCr₂O_{4”} *J. Phys.:Condens. Matter.* **21** (2009) 456008.

Charles P. Poole, Jr., Horacio A. Farach, “Magnetic phase diagram of spinel spin-glasses” *Z. Phys. B- Cond. Mater.* **47** 1982 55-57.

Chen, X., Yang, Z., Xie, Y., Huang, Z., Ling, L., Zhang, S., Pi, L., Sun, Y., Zhang, Y., “Coexistence of incommensurate and commensurate spiral orders and pressure effect on polycrystalline CoCr₂O_{4”} *J. Appl. Phys.* **113** (2013) 17E129.

Cherepanov, V. M., Bush, A. A., Shkuratov, V. Y., Kamentsev, K. E., “X-ray, Mossbauer, and dielectric studies of the Co_{1-x}Ni_x Cr₂O₄ ceramic system” *Bulletin Russian Academy of science, Physics* **77** (6) (2013) 663-667.

Choi, Y. J., Okamoto, J., Huang, D. J., Chao, K. S., Lin, H. J., Chen, C. T., Veenendaal, M., Kaplan, T. A., Cheong, S-W., “Thermally or magnetically induced polarization reversal in the multiferroic CoCr₂O_{4”} *Phys. Rev. Lett.* **102** (2009) 067601.

Coey, J. M. D., Noncollinear spin arrangement in ultrafine ferrimagnetic crystallites. *Physical Review Letters* **27** (17) (1971) 1140.

Cullity, B. D., Graham, C. D., Introduction to magnetic materials, John Wiley& Sons, 1972.

Cullity, B. D., “Introduction to Magentic Materials” *Addison-Wesley Publishing Company, Inc.*, **1972**; ISBN: 0201012189.

D

Das, D.; Biswas, R.; Ghosh, S., “Systematic analysis of structural and magnetic properties of spinel CoB₂O₄ (B= Cr, Mn and Fe) compounds from their electronic structures” *Journal of Physics: Condensed Matter* **28** (44) (2016) 446001.

Dimple, P. D., Manjanna, J., Tyagi, A. K., “Magnetic properties of sonochemically synthesized CoCr₂O₄ nanoparticles” *J. Appl. Phys.* **106** (2009) 043915.

Dwight, K.; Menyuk, N., “Distant-Neighbor B-B Interactions in Cobalt Chromite” *Journal of Applied Physics* **40** (3) (1969) 1156-1157.

E

Ederer, C., Komelj, M., “Magnetic coupling CoCr₂O₄ and MnCr₂O₄: An LSDA+U study” *Phys. Rev. B* **76** (2007) 064409.

Eerenstein, W., Mathur, N. D., Scott, J. F., “Multiferroic and magnetoelectric materials” *Nature* **442** (2006) 759-765.

F

Fisher, D. S., Huse, D. A., “Nonequilibrium dynamics of spin glasses” *Phys. Rev. B* **38** (1988) 373.

Fisher, D. S., Huse D. A., “Equilibrium behavior of the spin-glass ordered phase” *Phys. Rev. B* **38** (1988) 386.

Fisher, D. S., Huse, D. A., “Ordered phase of short-range ising spin-glasses” *Phys. Rev. Lett.* **56** 15 (1986) 1601.

Franco Jr, A.; e Silva, F., Effect of the Zn content in the magnetic properties of $\text{Co}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ mixed ferrites. *Journal of Applied Physics* **113** (17) (2013) 17B513.

Funahashi, S., Morii, Y., Child, H. R., “Two-dimensional neutron diffraction of YFe_2O_4 and CoCr_2O_4 ” *J. Appl. Phys.* **61** (1987) 4114.

G

Galivarapu Jagadish K.; Kumar, D.; Banerjee, A.; Sathe, V.; Aquilanti, G.; Rath, C., “Effect of size reduction on cation distribution and magnetic transitions in CoCr_2O_4 multiferroic: EXAFS, magnetic and diffused neutron scattering measurements” *RSC Advances* **6** (68) (2016) 63809-63819.

Godsell, J. F., Bala, T., Ryan, K. M., Roy, S., “An ac susceptibility study in capped $\text{Ni}/\text{Ni}(\text{OH})_2$ core-shell nanoassemblies: dual peak observations” *J. Phys. D : Appl. Phys.* **44** (2011) 325004.

Golosovsky, I.; Mirebeau, I.; André, G.; Kurdyukov, D.; Kumzerov, Y. A.; Vakhrushev, S., “Magnetic ordering and phase transition in MnO embedded in a porous glass” *Physical review letters* **86** (25) (2001) 5783.

Golosovsky, I.V., Mirebeau, I.; Andre, G. Kurdyukow, D. A., Kumzerov, Yu, A., Vakhrushev, S. B., “Magnetic Ordering and Phase Transition in MnO Embedded in a Porous Glass” *Phy. Rev. Lett.* **86** (2001) 25.

Groot De, F., “High-resolution X-ray emission and X-ray absorption spectroscopy” *Chemical Reviews* **101** (6) (2001) 1779-1808.

Grunes, L., “Study of the K edges of 3 d transition metals in pure and oxide form by x-ray-absorption spectroscopy” *Physical Review B* **27** (4) (1983) 2111.

Guo, S., Liu, W., Meng, H., Liu, X. H., Gong, W. J., Han, Z., Zhang, Z. D., “Exchange bias and its training effect in Ni/ NiO nanocomposites” *J. Alloys Compd.*, **497** (2010) 10-13.

Guo, S., Liu, X. H., Cui, W. B., Liu, W., Zhao, X. G., Li, D., Zhang, X. D., “Unconventional exchange bias in $\text{CoCr}_2\text{O}_4/\text{Cr}_2\text{O}_3$ nanocomposites” *J. Appl. Phys.* **105** (2009) 064702.

H

Hakim, M. A., Haque, M. M., Huq, M., Nordblad, P., “Spin-glass-like ordering in the spinel ZnFe₂O₄ ferrite” *Physica B* **406** (2011) 48-51.

Hankare, P. P., “Synthesis and characterization of cobalt substituted zinc ferri-chromites prepared by sol-gel auto-combustion method” *J. Mater. Sci- Mater. El.* **22** (8) (2011) 1109-1115.

Hankare, P. P., Sanadi, K. R., Mali, A. V., Garadkar, K. M., Delekar, S. D., Mulla, I. S., “Effect of cobalt doping on structural and thermoelectrical power of zinc alluchromites synthesized by sol-gel auto-combustion method” *Materials Letters* **110** (2013) 42-44.

Honeybourne, C. I., Rasheed, R. K., *J. Mater. Chem.* **6** (1996) 227.

Hu, J., Zhao, W., Hu, R., Chang, G., Li, Chun., Wang, L., “Catalytic activity of spinel oxides MgCr₂O₄ and CoCr₂O₄ for methane combustion” *Mater. Res. Bull.* **57** (2014) 268-273.

I

Iglesias, O., Xavier, B., Labarta, A., “Microscopic origin of exchange bias in core/shell nanoparticles” *Phys. Rev. B* **72** (2005) 121401.

Ijiri, Y., Sculthess, T. C., Borchers, J. A., Zaag, P. J. V. D., Erwin, R. W., “Link between perpendicular coupling and Exchange bias in Fe₃O₄/CoO Multilayers” *Phys. Rev. Lett.* **99** (2007) 147201.

J

Jadhav, S. S.; Shirasath, S. E.; Patange, S. M.; Jadhav, K., “Effect of Zn substitution on magnetic properties of nanocrystalline cobalt ferrite” *Journal of Applied Physics* **108** (9) (2010) 093920.

Jagadish, K. G., Kumar, D., Banerjee, A., Sathe, V., Aquilanti, G., Rath, C., “Effect of size reduction on cation distribution and magnetic transitions in CoCr₂O₄ multiferroic: EXAFS, magnetic and diffused neutron scattering measurements” *RSC Adv.* **6** (68) (2016) 63809.

Jebarathinam, N. J., Eswaramoorthy, M., Krishnasamy, V., “Dehydrogenation of Ethylbenzene over spinle oxides” *Bull. Chem. Soc. Japan* **67** (1994) 12.

Jeffrey F Godsell, Tanushree Bala, Kevin M.Ryan and Saibal Roy, “An ac susceptibility study incapped Ni/Ni(OH)₂ core-shell nanoassemblies; dual peak observations” *J. Phys. D : Appl. Phys.* **44** (2011) 325004.

Jonsson, P. E., Mathieu, R., Nordblad, P., Yoshino, H., Aruga, K. H., Ito, A., “Nonequilibrium dynamics of spin glasses: Examination of the ghost domain scenario” *Phys. Rev. B* **70** (2004) 174402.

Jonsson, T., Jonason, K., Jönsson, P., Nordblad, P., “Nonequilibrium dynamics in a three-dimensional spin glass” *Phys. Rev. B* **Vol. 59** No. 13 (1999) 8770.

K

Kanomata, T., Yasui, H., Kaneko, T., “Effect of pressure on the curie temperature of CoCr_2O_4 ” *Physics letters A* 134 (1988) 3.

Karman, M., Nadeem, K., Mumtaz, M., “Negative and anomalous T-dependent magnetization trend in CoCr_2O_4 nanoparticles” *Solid State Sci.* **72** (2017) 21-27.

Keller, J., Miltenyi, P., Beschoten, B., Güntherodt, G., Nowak, U., Usadel, K. D., “Domain state model for exchange bias II Experiments” *Phys. Rev. B* **66** (2002) 014431.

Kemei, M. C., Moffitt, S. L., Shoemaker, D. P., Seshardi, R., “Evolution of magnetic properties on the normal spinel solid solution $\text{Mg}_{1-x}\text{Cu}_x\text{Cr}_2\text{O}_4$ ” *Journal of Physics: Condensed Matter* **24** (2012) 046003.

Kemei, M. C.; Moffitt, S. L.; Darago, L. E.; Seshadri, R.; Suchomel, M. R.; Shoemaker, D. P.; Page, K.; Siewenie, J., “Structural ground states of (A, A') Cr_2O_4 (A= Mg, Zn; A'= Co, Cu) spinel solid solutions: Spin-Jahn-Teller and Jahn-Teller effects” *Physical Review B* **89** (17) (2014) 174410.

Khurshid, H., Li, W., Phan, M-H., Mukherjee, P., Hadjipanayis, G.C., Srikanth, H., “Surface spin disorder and exchange-bias in hollow maghemite nanoparticles” *Appl. Phys. Lett.* **101** (2012) 022403.

Khurshid, H., Phan, M-H., Mukherjee, P., Srikanth, H., “Tuning exchange bias in $\text{Fe}/\gamma\text{-Fe}_2\text{O}_3$ core-shell nanoparticle: Impacts of interface and surface spins” *Appl. Phys. Lett.* **104** (2014) 072407.

Kim, D-C., Ihm, S-K., “Application of spinel-type cobalt chromite as a novel catalyst for combustion of chlorinated organic pollutants” *Environ. Sci. Technol.* **35** (2001) 222-226.

Kim, I., Oh, Y. S., Liu, Y., Chun, S. H., Lee, J-S., Ko, K-T., Park, J-H., Chung, J-H., Kim, K-H., “Electric polarization enhancement in multiferroic CoCr_2O_4 crystals with Cr-site mixing” *Appl. Phys. Lett.* **94** (2009) 042505.

Kiran, S., Maignan, A., Simon, C., Martin, C., “ FeCr_2O_4 and CoCr_2O_4 spinels: Multiferroicity in the collinear magnetic state?” *Appl. Phys. Lett.* **99** (2011) 172903.

Kitani S., Tachibana, M., Taira, N., Kawaji, H., “Thermal Study of The Interplay Between Spin and Lattice in CoCr_2O_4 and CdCr_2O_4 ” *Phys. Rev. B* **87** (2013) 064402.

Kitani, S., Tachibana, M., Taira, N., Kawaji, H., “Thermal study of the interplay between spin and lattice in CoCr_2O_4 and CdCr_2O_4 ” *Phys. Rev. B* **87** (2013) 064402.

Kiwi, M., “Exchange bias theory” *J. Magn. Magn. Mater* **234** (3) (2001) 584.

Kochur, A. G., Kozakov, A. T., Googlev, K. A., Kubrin, S. P., Nikolskii, A. V., Torgashev, V. I., Bush, A. A., Shkuratov, V. Ya., Shevtsova, S. I., “Valence state of

transition metal ions in $\text{Co}_{1-x}\text{Fe}_x\text{Cr}_2\text{O}_4$ ($x=0.1, 0.2, 0.5$) ceramics from X-ray photoelectron and Mossbauer spectroscopy data” *J. Alloys. Compd.* **636** (2015) 241-248.

Kodama, R. H.; Berkowitz, A. E., “Surface Spin Disorder in NiFe_2O_4 Nanoparticles” *Phys. Rev. B* **77** (1996) 2.

Kodama, R.H., Berkowitz, A.E., McNiff, Jr. E.J., Foner, S. “Surface spin disorder in ferrite nanoparticles (invited)” *J.Appl.Phys.* **81** (1997) 5552.

Kools, J. C. S., “Exchange-biased spin-valves for magnetic storage” *IEEE Trans. Magn.* **32** (4) (1996) 3165.

Kumar, D., Galivarapu, J. K., Banerjee, A., Nemkovski, K. S., Su, Y., Rath, C., “Size-dependent magnetic transitions in $\text{CoFe}_{0.1}\text{Cr}_{1.9}\text{O}_4$ nanoparticles studied by magnetic and neutron-polarization analysis” *Nanotechnology* **27** (2016) 175702.

Kumar, D., Mohanty, P., Singh, V. P., Jagadish, K. G., Banerjee, A., Ganesan,V., Rath, C. “Tuning of magnetic transition temperatures in nanoparticles of CoCr_2O_4 multiferroic by B-site mixing” *Mater. Res. Bull.* **54** (2014) 78-83.

Kumar, D.; Banerjee, A.; Mahmoud, A.; Rath, C., “Cation distribution dependent magnetic properties in $\text{CoCr}_{2-x}\text{Fe}_x\text{O}_4$ ($x= 0.1$ to 0.5): EXAFS, Mössbauer and magnetic measurements” *Dalton Transactions* **46** (31) (2017) 10300-10314.

L

La-Orautapong, D., Toulouse, J., Robertson, J.L., Ye, Z.-G. “Diffuse Neutron Scattering Study of a Disordered Complex Pervskite $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_3$ crystal” *Phys. Rev. B* **64** (2001) 212101.

Lawes, G., Melot, B., Page, K., Ederer, C., Hayward, M.A., Proffen, Th., Seshadri, R. “Dielectric Anomalies and Spiral Magnetic Order in CoCr_2O_4 ” *Phys. Rev. B* **74** (2006) 024413.

Lee, J. D., *Concise inorganic chemistry*. John Wiley & Sons: 2008.

Lefloch, F., Hammann, J., Ocio, M., Vincent, E., “Can aging phenomena discriminate between the droplet model and a hierarchical description in spin glasses?” *Europhys. Lett.* **18** 7 (1992) 647-652.

Lei, S., Liu., L., Wang, C., Shen, X., Wang, C., Guo, D., Zeng, S., Cheng, B., Xiao, Y., Zhou, L., “A facile insitu reduction route for preparation of spinel CoCr_2O_4 polycrystalline nanosheets and their magnetic properties” *Cryst. Eng. Comm.* **16** (2014) 277.

Li, S., Zhao, G., Bi, H., Huang, Z., Lai, H., Gai, R., Du, Y., “Synthesis and anomalous magnetic properties of CoCr_2O_4 nanocrystallites with lattice distortion” *J. Magn. Magn. Mater.* **305** (2) (2006) 448-451.

Liu, Y., Fergus, J. W., Cruz, C. D., "Electrical properties, cation distributions, and thermal expansion of manganese cobalt chromite spinel oxides" *J. Am. Ceram. Soc.*, **96** (6) (2013) 1841-1846.

Lyons, D. H., Kaplan, T. A., Dwight, K., Menyuk, N., "Classical theory of the ground spin-state in cubic spinels" *Phys. Rev.* **126** (2) (1962) 540.

M

Maaz, K., Duan, J. L., Karim, S., Chen, Y. H., Yao, H. J., Mo, D., Sun, y. m., Liu, J., "Fabrication and low temperature magnetic studies of Ni-Co core-shell nanowires" *J. Alloys Compd.* **662** (2016) 296-301.

Maaz, K., Usman, M., Karim, S., Mumtaz, A., Hasanain S. K., Bertino, M. F., "Magnetic response of core-shell cobalt ferrite nanoparticles at low temperature" *J. Appl. Phys.* **105** (2009) 113917.

Maaz, K., Usman, M., Karim, S., Mumtaz, A., Hasanain, S. K., Bertino, M. F., "Magnetic response of core-shell cobalt ferrite nanoparticles at low temperature" *J. Appl. Phys.* **105** (2009) 113917.

Maczka, M., Ptak, M., Kurnatowska, M., Hanuza, J., "Synthesis. Phonon and optical properties of nanosized CoCr_2O_4 " *J. Mater. Chem. Phys.* **138** (2013) 682-688.

Marquez, G., Sagredo, V., Marquina, C., Torres, T. E., Ibarra, M. R., Goya, G. F., "Magnetic properties of $\text{CoFe}_{0.5}\text{Cr}_{1.5}\text{O}_4$ nanoparticles" *Revista Mexicana de Fisica S* **58** (2) (2012) 138-141.

Martinho, H., Moreno, N. O., Sanjurjo, J. A., Rettori, C., Adeva, A. J., Huber, D. L., Oseroff, S.B., Ratcliff II, W, Cheong, S.-W., Pagliuso, P. G., Sarrao, J. L., Martins, G. B., "Magnetic properties of the frustrated antiferromagnetic spinel ZnCr_2O_4 and the spin-glass $\text{Zn}_{1-x}\text{Cd}_x\text{Cr}_2\text{O}_4$ ($x=0.15,0.1$)" *Phys. Rev. B* **64** (2001) 024408.

Masrour, R., Elegrini, A., Hamedoun, M., Benyoussef, A., Hourmatallah, A., Benzakour, N., "Study of magnetic properties in spinels $\text{Co}_x\text{Zn}_{1-x}\text{Cr}_2\text{O}_4$ systems" *J. Supercond. Nov. Magn.* **25** (2012) 1093-1096.

Mathieu, R., Jonsson, P., Nam, D. N. H., Nordblad, P., "Memory and superposition in a spin glass" *Phys. Rev. B* **63** (2001) 092401.

Meiklejohn, W. H., Bean, C. P., "New magnetic anisotropy" *Phys. Rev.* **105** (1957) 904.

Melot, B. C., Drewes, J. E., Seshadri, R., Stoudenmire, E. M., Ramirez A. P., "Magnetic Phase evolution in the spinel compounds $\text{Zn}_{1-x}\text{Co}_x\text{Cr}_2\text{O}_4$ " *Journal of Physics: Condensed Matter* **21** (2009) 216007.

Menyuk, N., Dwight, K., Wold, A., "Ferrimagnetic spiral configurations in cobalt chromite" *Le Journal De Physique*, **25** (1964) 528.

Moulton, K., Beal, R., "Nickel/copper chromite catalysts for hydrogenating edible oils" US patent No. **3856710A**, 1974.

Mufti, N., Nugroho, A. A., Blake, G R., Palstra, T. T. M. "Magnetodielectric coupling in frustrated spin systems: the spinels $M\text{Cr}_2\text{O}_4$ ($M=\text{Mn, Co, Ni}$)" *J. Phys.: Condens. Matter* **22** (2010) 075902.

Mumtaz, A., Maaz, K., Janjua, B., Hasanain, S. K., Bertino, M. F., "Exchange bias and vertical shift in CoFe_2O_4 nanoparticles" *J. Magn. Magn. Mater.* **313** (2007) 266-272.

Murdock, S. H., Eppler, R. A., "Zinc iron chromite pigments", *J. Am. Ceram. Soc.*, **71** (4) (2005) C 212-C 214.

Muroi, M., McCormick, P. G., Street, R., "Surface spin disorder and exchange bias in $\text{La}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$ nanoparticles synthesized by mechanochemical processing" *Rev. Adv. Mater. Sci.* **5** (2003) 76-81.

Mydosh, J.A.; Spin Glasses: An Experimental Introduction, Taylor and Francis, London **1993**.

N

Nadeem, K., Kreen, H., Szabo, D. V., "Memory effect versus exchange bias for maghemite nanoparticles" *J. Magn. Magn. Mater.* **393** (2015) 239-242.

Nagornyi, A. V., Petrenko, V. I., Avdeev, M. V., Bulavin, L. A., Aksenov, V. L., "Analysis of Small-Angle Neutron Scattering from Very Dilute Magnetic Fluids" *J. Surf. Invest-X-ray* **4** (6) (2010) 976-981.

Newville, M.; Ravel, B.; Haskel, D.; Rehr, J.; Stern, E.; Yacoby, Y., "Analysis of multiple-scattering XAFS data using theoretical standards" *Physica B: Condensed Matter* **208** (1995) 154-156.

Nogues, J., Schuller, I. K., "Exchange bias" *J. Magn. Magn. Mater.* **192** (2) (1999) 203.

Nogues, J., Sort, J., Langlais, V., Skymryev, V., Surinach, S., Munoz J., Baro, M. D., "Exchange bias in nanostructures", *Phys. Rep.* **65** (422) (2005) 65-117.

O

Okamoto, Y.; Nakano, H.; Imanaka, T.; Teranishi, S., "X-Ray Photoelectron Spectroscopic Studies of Catalysts—Supported Cobalt Catalysts". *Bulletin of the Chemical Society of Japan* **48** (4) (1975) 1163-1168.

P

Padam, R., Pandya, S., Ravi, S., Nigam, A. K., Ramakrishna, S., Grover, A. K., Pal, D., "Magnetic compensation effect and phase reversal of exchange bias field across

compensation temperature in multiferroic $\text{Co}(\text{Cr}_{0.95}\text{Fe}_{0.05})_2\text{O}_4$ " *Appl. Phys. Lett.* **102** (2013) 112412.

Padam, R., Ravi, S., Ramakrishna, S., Grover, A. K., Pal, D., "Exchange bias in non-collinear spin-spiral systems $\text{Co}(\text{Cr}_{1-x}\text{Co}_x)_2\text{O}_4$ ($x=0.0-0.1$)" *J. Magn. Magn. Mater.* **371** (2014) 144-148.

Pankaj, C., Dinesh, V., "Structural, vibrational and dielectric behavior of $\text{Co}_{1-x}\text{M}_x\text{Cr}_2\text{O}_4$ ($\text{M}=\text{Zn}, \text{Mg}, \text{Cu}$ and $x=0.0, 0.5$) spinel chromites" *J. Alloys Compd.* **725** (2017) 415-424.

Petra, J., Hansen, M. F., Svedlind, P., Nordbald, P., "Memory effects in an interacting magnetic nano-particle sample" *Physica B* **284-288** (2000) 1754-1755.

Plumier, R., "Reinvestigation of magnetic structures of CoCr_2O_4 and MnCr_2O_4 obtained by neutron diffraction" *Journal of Applied Physics* **39** (2) (1968) 635-636.

Poddar, P.; Telem-Shafir, T.; Fried, T.; Markovich, G., "Dipolar interactions in two-and three-dimensional magnetic nanoparticle arrays" *Physical Review B* **66** (6) (2002) 060403.

Pronin, A. V., Uhlarz, M., Beyer, R., Fischer, T., Wosnitza, Gorshunov, B. P., Komandin, G. A., Prokhorov, A. S., Dressel, M., Bush, A. A., Torgashev, V. I., "B-T phase diagram of CoCr_2O_4 in magnetic fields upto 14 T" *Phys. Rev. B* **85** (2012) 012101.

Ptak, M., Maczka, M., Hermanowicz, K., Pikul, A., Hanuza, J., "Particle size effects on the magnetic and phonon properties of multiferroic CoCr_2O_4 " *J. Solid State Chem.* **199** (2013) 295-304.

Ptak, M., Maczka, M., Pikul, A., Tomaszewski, P. E., Hanuza, J., "Magnetic and low temperature phonon studies of CoCr_2O_4 powders doped with Fe(III) and Ni(II) ions" *J. Solid State Chem.* **212** (2014) 218-226.

R

Ram, K., Padam, R., Das, D., Rayaprol, S., Siruguri, V., Pal, D., " Low temperature neutron diffraction studies on $\text{Co}(\text{Cr}_{1-x}\text{Fe}_x)_2\text{O}_4$ ($X=0.05$ and 0.075)" *RSC Adv.*, **6** (2016) 93511.

Ram, K., Rayaprol. S., Siruguri, V., Xiao, Y., Ji, W., Pal, D., "Magneto-structural correlation in $\text{Co}_{0.8}\text{Cu}_{0.2}\text{Cr}_2\text{O}_4$ cubic spinel" *J. Magn. Magn.Mater.* **454** (2018) 342-348.

Rath, C., Anand, S., Das, R.P., Sahu, K. K., Kulkarni, S. D., Date, S. K., Mishra, N.C., "Dependence on Cation Distribution of Particle Size, Lattice Parameter, and Magntic Properties in nano size Mn-Zn ferrite", *J. Appl. Phys.* **91** 4 (2002) 2211.

Rath, C., Mishra, N. C., Anand, S., Das, R. P., Sahu, K. K., Upadhyay, C., Verma, H. C., "Appearance of superparamagnetism on heating nanosize $\text{Mn}_{0.65}\text{Zn}_{0.35}\text{Fe}_2\text{O}_4$ " *Appl. Phys. Letter* **76**(4) (2000) 475-477.

Rath, C., Sahu, K. K., Anand, S., Date, S. K., Mishra, N. C., Das, R. P., "Preparation and characterization of nanosize Mn-Zn ferrite" *J. Magn. Magn. Mater.* **202**(1999) 77.

Rath, C.; Mohanty, P.; Banerjee, A., "Magnetic properties of nanoparticles of cobalt chromite" *J. Magn. Magn. Mater.* **323** (12) (2011) 1698-1702.

S

Sahoo, S., Petracic, O., Kleemann, W., Nordblad, P., "Aging and memory in a superspin glass" *Phys. Rev. B*, 67 2003 214422

Sasaki, M, Jonsson, P. E., Takayama, H., Mamiya, H., "Aging and memory effect in superparamagnets and superspin glasses" *Phys. Rev. B* **71** (2005) 104-105

Sayan Chandra, Khurshid, H., Wanfeng Li, Hadjipanayis, G. C., Phan, M. H., Srikanth, H., "Spin dynamics and criteria for onset of exchange bias in superspin glass Fe/ γ -Fe₂O₃ core-shell nanoparticles" *Phys. Rev. B* **86** (2012) 014426.

Schlenker, C., Parkin, S. S. P., Scott, J. C., Howard, K., "Magnetic disorder in the exchange bias bilayered FeNi_FeMn system" *J. Magn. Magn. Mater.* **801** (1986) 54-57.

Severance, K., Edge, R., "Spin glass behavior in a single crystal of chromite" *Am. Miner.* **78** (1993) 724-732.

Shruti, T., Sa, D., "A phenomenological landau theory for electromagnons in cubic spinel multiferroic CoCr₂O₄" *J. Phys.: Condens. Matter.* **22** (2010) 225903.

Sickafus, K. E., Wills, J. M., Grimes, N. W., "Spinel compounds: Structure and property relations" *J. Am. Ceram. Soc.*, 82 (12) (1999) 3279-92.

Smit, J., Wijn, H. P. J., Ferrites, John Wiley & Sons, New York, 1959.

Stamps, R. L., "Mechanisms for exchange bias" *J. Phys. D : Appl. Phys.* **33** (2000) R247.

Strawbridge, A., Stott, F. H., Wood, G. C., "The formation and incorporation into the scale of internal oxides developed during the high-temperature oxidation of dilute nickel-base alloys. *Corrosion Science* **35** (1993) 852-855.

Suchomski, C., Reitz, C., Brezesinski, K., Tavares de Sousa, C., Rohnke, M., Iimura, K-I, Joao, P. E. de. A., Brezesinski, T., " Structural, optical and magnetic properties of highly ordered mesoporous MCr₂O₄ and MCr_{2-x}Fe_xO₄ (M= Co, Zn) spinel thin films with uniform 15 nm diameter pores and tunable nanocrystalline domain sizes" *Chem. Mater.* **24** (2012) 155-165.

Sun, C.C., Hawk, E.W., Sverdrup, E. F., " Electrical evaluation of doped and undoped cobalt chromite as interconnection material for high temperature, Zirconia-electrolyte, Fuel-cell batteries" *J. Electrochem. Soc.*, 119 (11) (1972) 1433-1438.

Sun, Y., Salamon, M . B., Garnier, K., Averback, R. S. “ Memory effects in an interacting magnetic nanoparticle system” *Phys. Rev. Lett.* **91** (16) (2003) 167206.

Suzuki, M., Fullem, S. I., Suzuki, I. S., Wang, I., Zhong, C-J, “Observation of superspin-glass behavior in Fe_3O_4 nanoparticles” *Phys. Rev. B* **79** (2009) 024418.

T

Tang, Z. X., Sorensen, C. M., Klabunde, K. J. “Size-dependent Curie Temperature in Nanoscale MnFe_2O_4 ” *Phy. Rev. Lett.* **67** (1991) 3602.

Tholence, J. L.; ed. Hein, R. A.; Francavilla T. L. and Liebenberg D. H., “Magnetic Susceptibility of Superconductors and Other Spin Systems” *Plenum Press New York* (1991) 503.

Tian, Z., Chen, J., Yuan, S., Tang, J., Huo, S., Duan, H., “Exchange bias effect in multiferroic $\text{CoCr}_2\text{O}_4/\text{Cr}_2\text{O}_3$ nanogranular system synthesized through a phase segregation route” *J. Appl. Phys.* **110** (2011) 053907.

Tian, Z., Zhu, C., Wang, J., Xia, Z., Lie, Y., Yuan, S., “Size dependence of structure and magnetic properties of CoCr_2O_4 nanoparticles synthesized by hydrothermal technique” *J. Magn. Magn. Mater.* **377** (2015) 176-182.

Tomiyasu, K., Fukunaga, J., Suzuki, H., “Magnetic Short-range Order and Reentrant-spin-glass-like behavior in CoCr_2O_4 and MnCr_2O_4 by means of neutron scattering and magnetization measurements” *Phys. Rev. B* **70** (21) (2004) 214434.

Tomiyasu, K., Kamazawa, K., “Neutron scattering study of CoCr_2O_4 ” *Physica B* 392 (2007) 16-19.

Topakaya, R., Akman, O., Kazan, S., Aktas, B., Durmus, Z., Baykal, A., “ Surface spin disorder and spin-glass-like behavior in manganese-substituted cobalt ferrite nanoparticles” *J. Nanopart. Res.* **14** (2012) 1156.

Torgashev, V. I., Prokhrov, A. S., Komandin, G. A., Zhukova, E. S., Anzin, V. B., Talanov, V. M., Rabkin, L. M., Bush, A. A., Dressel, M., Gorshunov, B P. “Magnetic and dielectric response of cobalt chromium spinel CoCr_2O_4 in the terahertz frequency range” *Phase transitions* **54** (2) (2012) 330-339.

Trohidou, K., Vasilakaki, M., Peddis, D., Fiorani, D., “Memory effects in ultra-small CoFe_2O_4 nanoparticles” *IEEE Trans. Magn.* **48** 4 (2012) 1305.

Tsang, C., Fontana, R. E., Lin, T., Heim, D. E., Speriosu, V. S., Gurney, B. A., Williams, M. L., “Design, fabrication and testing of spin-valve read heads for high density recording” *IEEE Trans. Magn.* **30** (1994) 3801.

Tsurkan, V., Zherliysyn, S., Yasin, S., Felea, V., Skourski, Y., Deisenhofer, J., Krug, H. – A. von N., Wosnitza, J., Loidl, A., “Unconventional magnetostructural transition in CoCr_2O_4 at high magnetic fields” *Phys. Rev. Lett.* **110** (2013) 115502.

V

Vasilakaki, M., Eftaxias, E., Trohidou, K. N., “Monte Carlo study of the exchange bias and the training effect in nanoparticles with core/shell morphology” *Phys. Stat. Sol. (a)* **205** 8 (2008) 1865-1871.

Vasilakaki, M., Trohidou, K. N., Peddis, D., Fiorani, D., Mathieu, R., Hudl, M., Nordbald, P., Binns, C., Baker, S., “Memory effects on the magnetic behavior of assemblies of nanoparticles with ferromagnetic core/antiferromagnetic shellmorphology” *Phys. Rev. B* **88** (2013) 140402.

Verde, E. L.; Landi, G.T.; Carrião, M. S.; Drummond, A. L.; Gomes, J. A.; Vieira, E. D.; Sousa, M. H.; Bakuzis, A.F. “Field dependent transition to the non-linear regime in magnetic hyperthermia experiment : Comparison between maghemite, copper, zinc, nickel and cobalt ferrite nanoparticles of similar sizes” *AIP Advances* **2** (2012) 032120.

Vincent, E., Bouchaud, J. P., Hammann, J., Lefloch, F., “Contrasting effects of field and temperature variations on ageing in spin glasses” *Philos. Mag. B* **71** (4) (1995) 489-500.

W

Wang, L. G., Zhu, C. M., Bao, D. L.G. C., Tian, Z. M., Yuan, S. L. “Giant exchange bias behavior and training effect in spin-glass-like NiCr₂O₄/NiO ceramics” *J. Mater. Sci.* **50** (2015) 5904-5911.

Y

Yafet, Y.; Kittel, C., Antiferromagnetic arrangements in ferrites. *Physical Review* **87** (2) (1952) 290.

Yamasaki, Y., Miyasaka, S., Kaneko, Y., He, J. P., Arima, T., Tokura, Y., “Magnetic Reversal of the Ferroelectric Polarization in a Multiferroic Spinel Oxide” *Phys. Rev. Lett.* **96** (2006) 207204.

Yi, J. B., Ding, J., Feng, Y. P., Peng, G.W., Chow, G. M., Kawazoe, Y., Liu, B.H., Yin, J. H., Thongmee, S., “Size-dependent magnetism and Spin-glass behavior of amorphous NiO Bulk, Clusters, and Nanocrystals: Experiments and first-principles Calculations” *Phys. Rev. B* **76** (2007) 224402.

Yokoyama, M., Ohta, E., Sato, T., Sato, T., “Magnetic Properties of Ultrafine particles and Bulk Material of Cadmium Ferrite” *J. Magn. Magn. Mater.* **183** (1998) 173.

Yoshino, H., Lemaitre, A., Bouchaud, J.-P., “Multiple domain growth and memory in the droplet model for spin-glasses” *Eur. Phys. J. B* **20** (2001) 367-395.

Z

Zhu, C., Tian, Z., Wang, L., Yuan, S., “ Exchange bias effect in spin glass CoCr₂O₄ nanoparticles” *J. Magn. Magn. Mater.* **393** (2015) 116-120