Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Anomalous enhancement of Neel temperature and magnetic coupling for $Bi_{0.9}Ca_{0.1}FeO_{3-\delta}$ and $Bi_{0.9}Pb_{0.1}FeO_{3-\delta}$ GOPESHMWAR-DHAR DWIVEDI, KUNG-SHANG YANG, BO-YU CHEN, HSIUNG CHOU[1], Dept. of Physics ,NSYSU, Kaohsiung 804, Taiwan — Temperature dependent neutron diffraction patterns of the Ca-doped $BiFeO_3$ and Pb-doped $BiFeO_3$ show that their Neel temperatures (T_N) increase to 710 K and 680 K, while pure $BiFeO_3$ has a T_N ˜643 K. X-ray absorption spectra clearly shows that there is no evidence of mixed valence states despite divalent cation doping in trivalent Bi-sites. X-ray photoemission spectroscopy study revealed that divalent doping has introduced oxygen vacancies in the system. Oxygen deficiency plays a significant role in contracting Fe-O bond length in Fe-O_6 octahedra and hence increasing the Fe-O-Fe bond angle in $Bi_{0.9}Ca_{0.1}FeO_{3-\delta}$ and $Bi_{0.9}Pb_{0.1}FeO_{3-\delta}$. The decreased Fe-O bond length and increased Fe-O-Fe bond angle favors the Goodenough-Kanamori-Anderson (GKA) coupling. The GKA coupling increases the magnetic interaction between the spins and hence increases the T_N. Additionally, doping of divalent cations (Ca^{2+} and Pb^{2+}) results in the destruction of cycloidal spin structure and formation of a simple antiferromagnetic (AFM) structure. This structure can easily be canted near the heterogeneous interface with a ferromagnetic layer to induce the Dzyaloshinskii-Moriya (DM) interaction and enhance the magneto-electric (M-E) coupling.

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Date submitted: 06 Nov 2015 Electronic form version 1.4