Hydrothermal synthesis of Co/MFe_2O_4 (M=Co, Ni, Zn) core/shell nanoparticles for self-bias magnetoelectric effect

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Magnetoelectric (ME) effect has engaged with strong interest due to its noteworthy characteristics for multiferroic devices. The ME effect, an induced electrical voltage by applying a bias magnetic field, can be obtained in multiferroic composites consisting both piezoelectric and magnetostrictive phases. Even though the ME composites exhibit highly reliable electrical voltage converged by a variation of small AC magnetic field, there is a requirement of applying DC magnetic field to induce ME responses. Recently, self-bias ME effect was reported with highlight of remanent ME response at zero DC magnetic field by Yang et al. However, in order to use the self-bias effect in potential applications, the magnitude of magnetostriction needs to be improved under zero DC magnetic field at off-resonance frequency. In this study, we have successfully synthesized bi-magnetic Co/MFe_2O_4 (M=Co, Ni, Zn) core/shell nanoparticles to obtain a high remanent magnetization being proportional to root of magnetostriction value ($M2\infty\lambda$). Consequently, M-H hysteresis loops of bimagnetic particles were investigated by variation of materials coupling effect. The core/shell structures were developed by hydrothermal synthesis.