An Unconventional Magnetoresistance in CoFe2O4 Core-BiFeO3 Shell Composite

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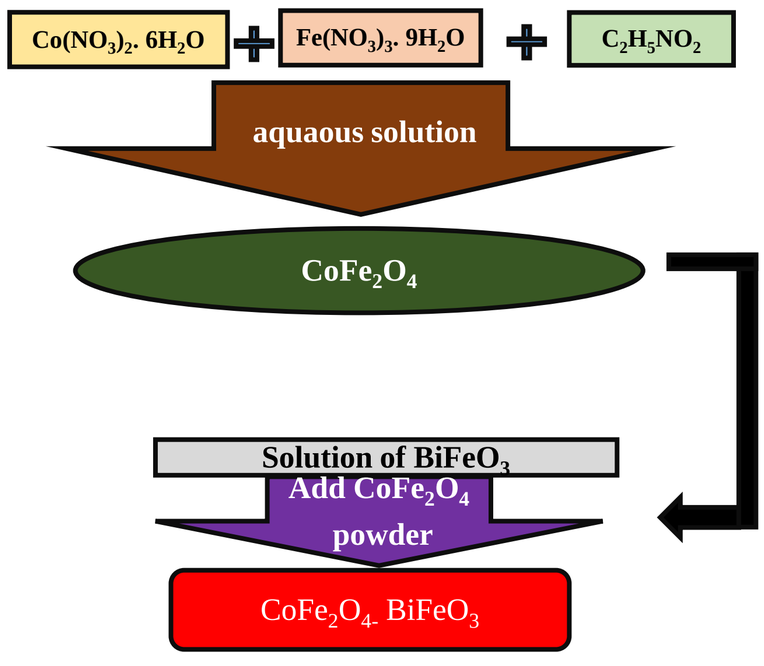
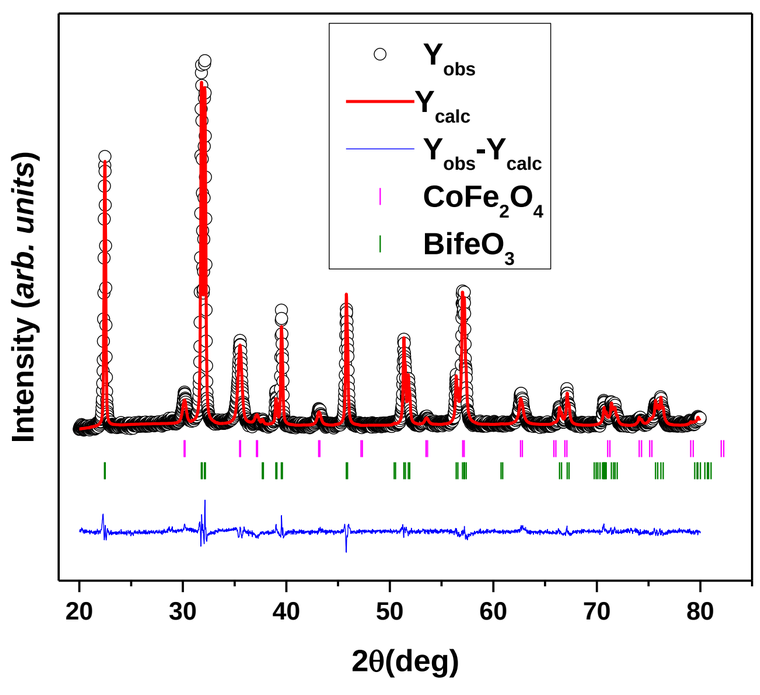
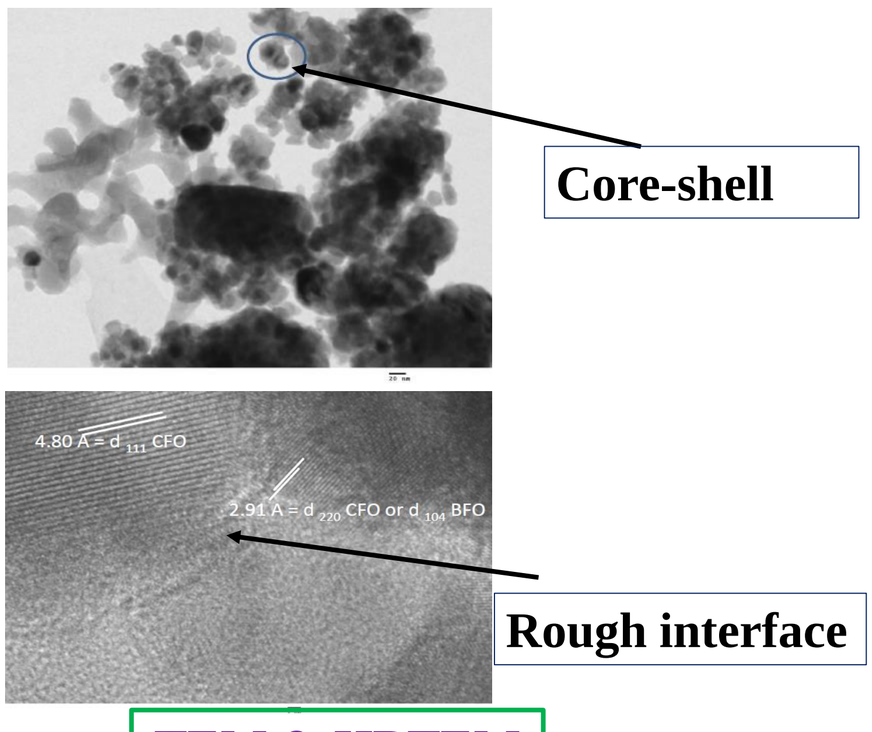
Abstract- Magnetodielectric and magnetoresistance measurements are performed on the 40%$CoFe_2O_4$-60%$BiFeO_3$ core-shell composite above room temperature. The high value of positive magnetodielectric behavior originates due to Maxwell-Wagner effect which is very much supportive with negative MR behavior. The room temperature magnetic field dependent MR indicates the conventional spin polarized tunneling mechanism through interface. A spin-valve action is spotted in MR at 350K with an irreversibility. The most interesting is the MR behavior at 400K. A number of peculiar behavior has been observed which is very unusual at high temperature.



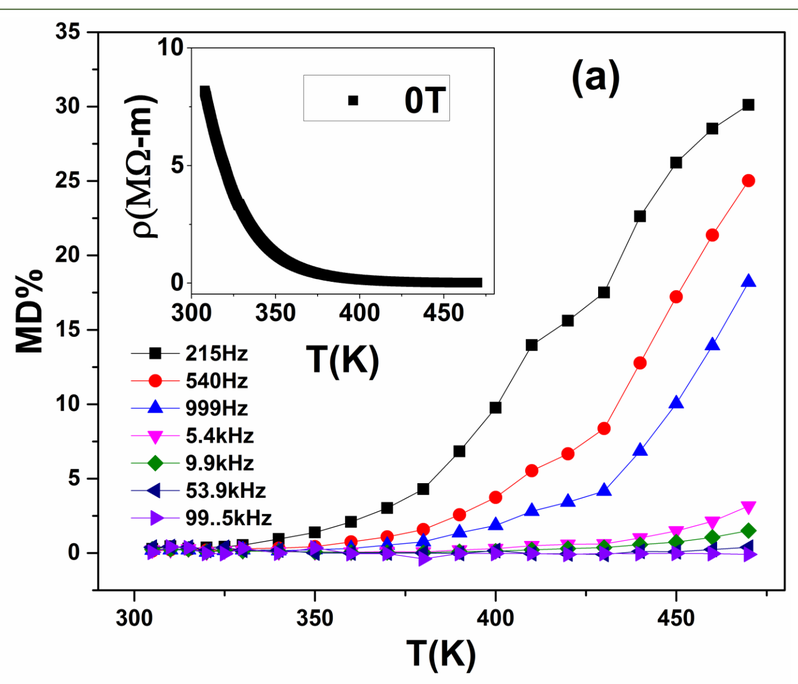
Sample synthesis



XRD refinement



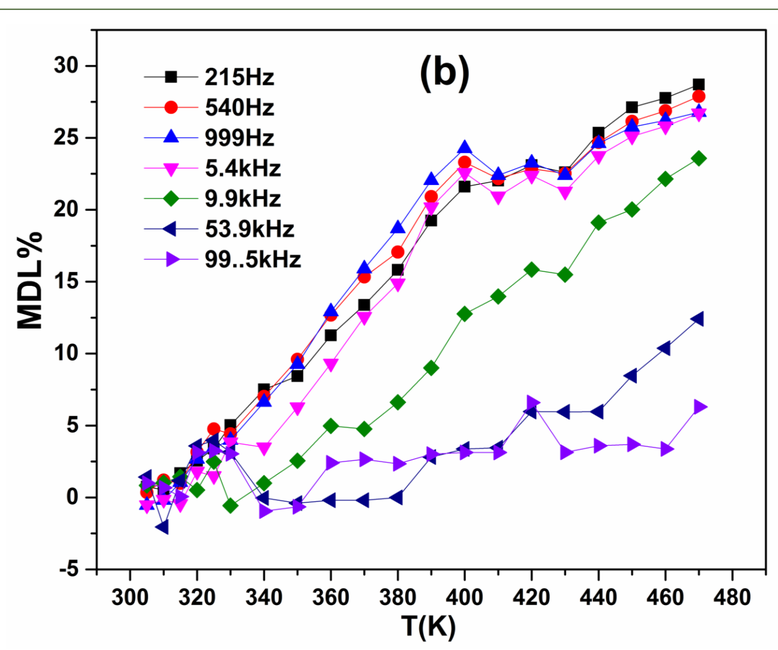
TEM & HRTEM



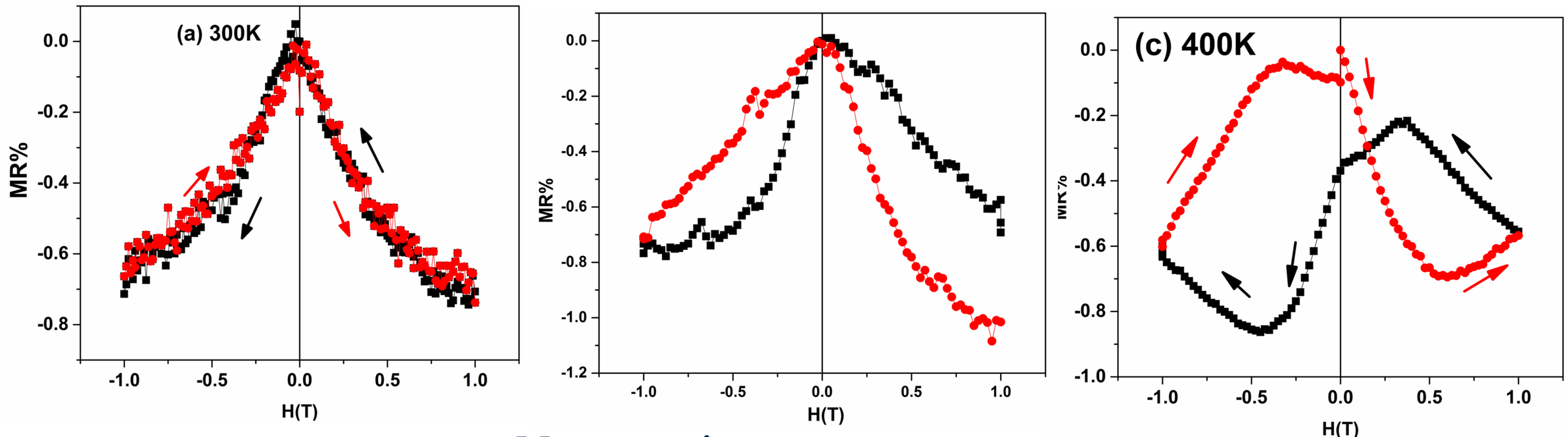
$$MD\% = \frac{\varepsilon(H)-\varepsilon(0)}{\varepsilon(0)} \times 100\%$$

$$MDL\% = \frac{tan\delta(H)-tan\delta(0)}{tan\delta(0)} \times 100\%$$

$$MR\% = \frac{R(H)-R(0)}{R(0)} \times 100\%$$



Magnetodielectric measurement



Magnetoresistance measurement

Conclusion-Above discussions indicate, the high value of MD of 40CFO-60BFO core-shell, which is observed at high temperature is the consequence of Maxwell-Wagner effect and magnetoresistance. In our core-shell material, magnetic field dependent MR at 300K shows conventional TMR like behavior, which is much expected. At 350K and 400K, spin-valve like mechanism is noticed, where large hysteresis behavior of MR at 400K is very unusual and interesting. An intermediate behavior has been observed at 350K, where TMR nature is seen with a small hysteresis. The physics behind these unusual behavior is still not clear. A systemetic study is required to unveil the origin of these behavior.