Supporting information section
Oriented attachment of ultra-small $Mn_{(1-x)}Zn_xFe_2O_4$ nanoparticles during the non-aqueous sol-gel synthesis

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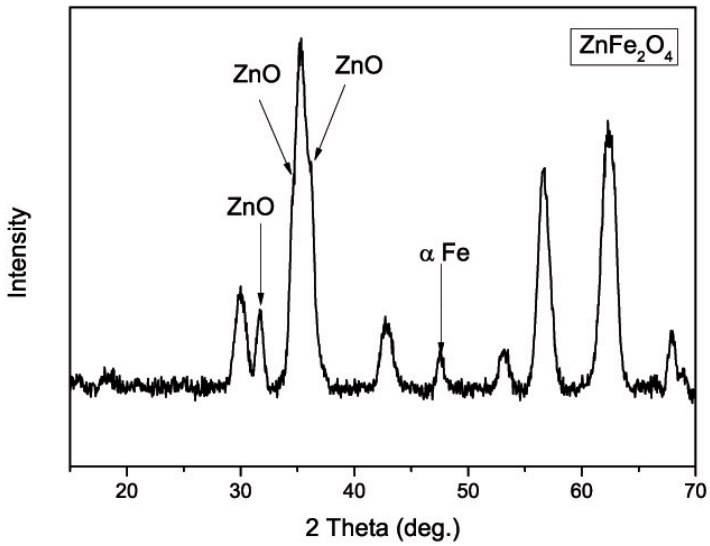

Figure 1: XRD pattern of $ZnFe_2O_4$ particles synthesized with $Zn(acac)_{hyd}$ as precursor.

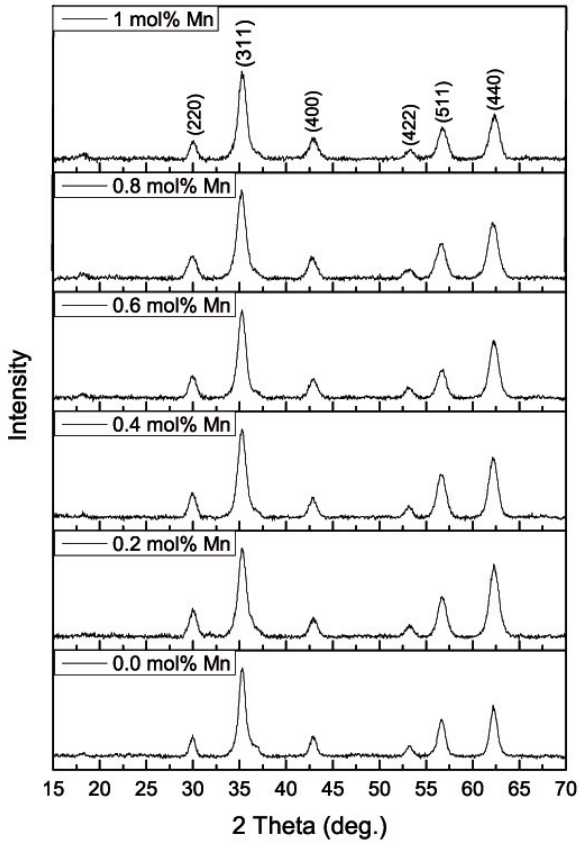

Figure 2: XRD patterns of the samples after calcination at 400°C for 2 h in a nitrogen atmosphere.

Table 1: Crystallite size of the dried particle samples calculated with the Scherrer equation.

sample	crystallite size [nm]
$MnFe_2O_4$	5.56
$Mn_{0.8}Zn_{0.2}Fe_2O_4$	5.31
$Mn_{0.6}Zn_{0.4}Fe_2O_4$	4.85
$Mn_{0.4}Zn_{0.6}Fe_2O_4$	5.87
$Mn_{0.2}Zn_{0.8}Fe_2O_4$	6.02
$ZnFe_2O_4$	8.77

Table 2: Crystallite size of the samples after calcination at 400°C for 2 h in a nitrogen atmosphere calculated with the Scherrer equation.

sample	size calcinated [nm]
$MnFe_2O_4$	8.59
$Mn_{0.8}Zn_{0.2}Fe_2O_4$	8.33
$Mn_{0.6}Zn_{0.4}Fe_2O_4$	8.96
$Mn_{0.4}Zn_{0.6}Fe_2O_4$	8.87
$Mn_{0.2}Zn_{0.8}Fe_2O_4$	8.41
$ZnFe_2O_4$	11.11

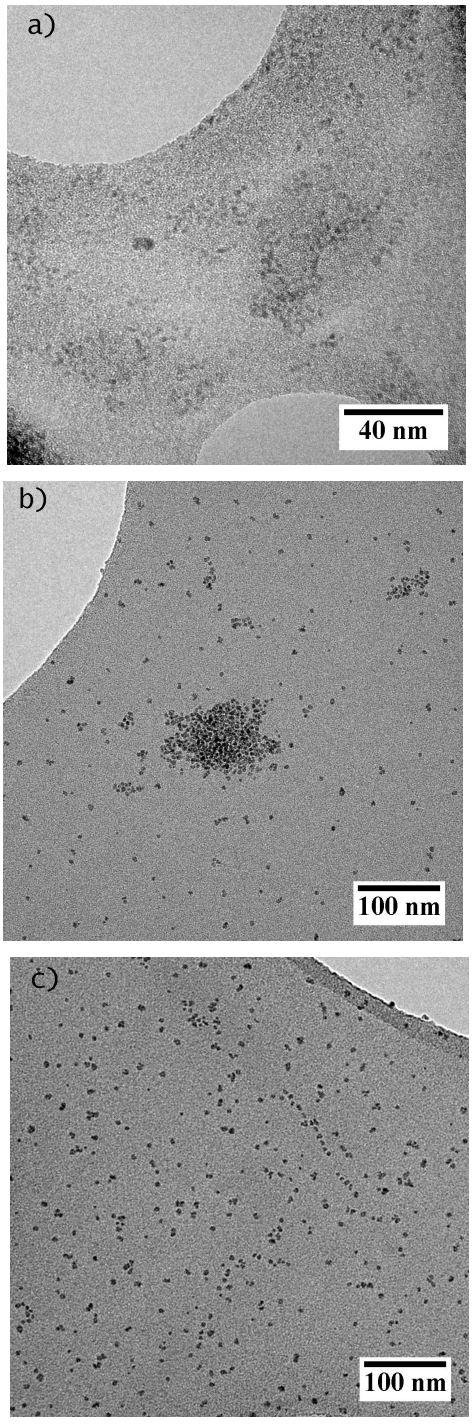

Figure 3: TEM images of the samples with $t_R = 2\,\mathrm{h}$ (a), $t_R = 8\,\mathrm{h}$ (b) and (c) $t_R = 14\,\mathrm{h}$.

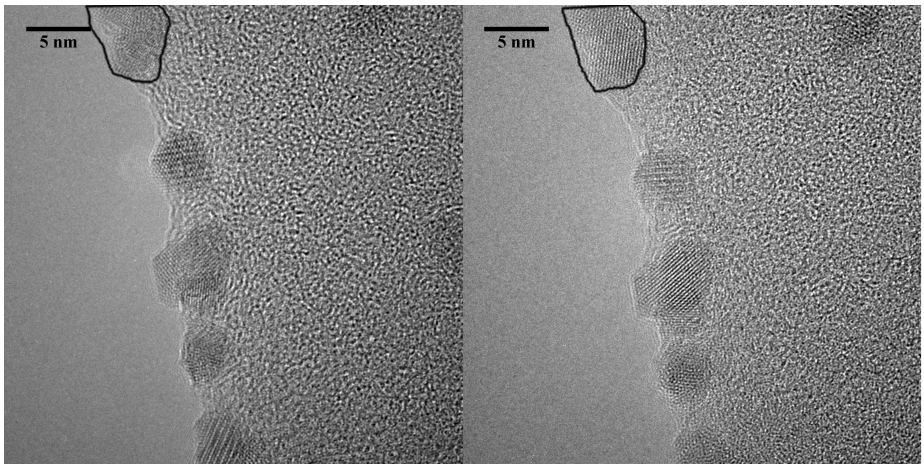

Figure 4: In situ TEM observation of oriented attachment of $Mn_{0.6}Zn_{0.4}Fe_2O_4$ nanoparticles. The images were taken at an interval of 5 minutes.

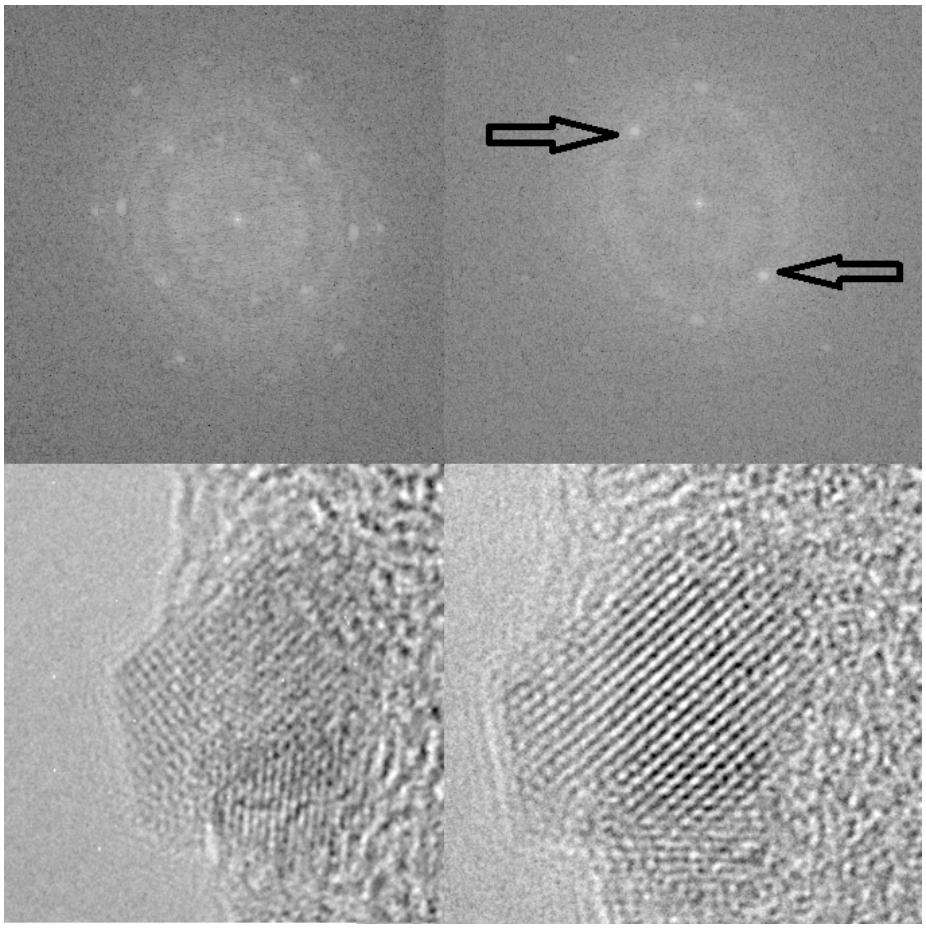

Figure 5: FFT images of the $Mn_{0.6}Zn_{0.4}Fe_2O_4$ nanoparticles during the oriented attachment. The crystallographic plane 311 with the d-spacing of 0.25 nm shows an increased resolution after the oriented attachment of the particles. Therefore we inferred that the 311 plane is the preferred orientation direction.

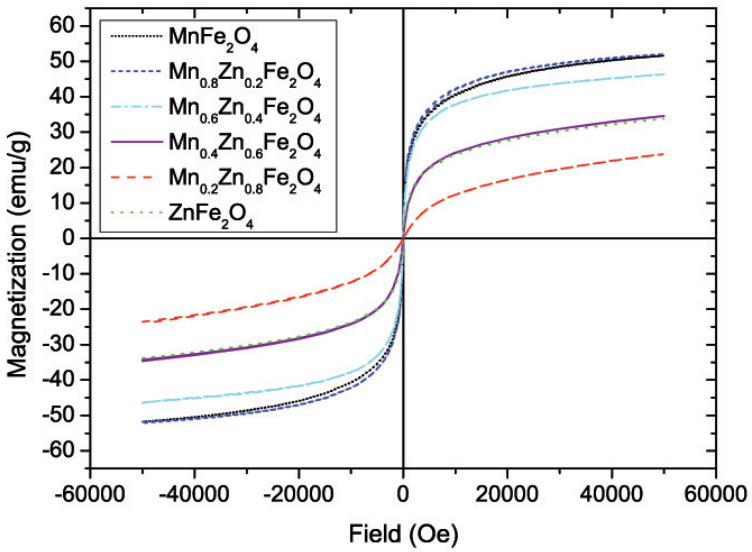

Figure 6: Hysteresis loops of the samples after calcination at $400°C$ for 2h in a nitrogen atmosphere.