Electronic Supplementary Information

Multiferroic Ferrite/Perovskite Oxide Core/Shell Nanostructures

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Fig. S1 (a), (b) TEM images of the Ti-hydroxide coated Fe₃O₄ particles and the corresponding EDS analysis from the edge (c) and center (d) of a Ti-hydroxide coated Fe₃O₄ particle (the signals of Cu and C are resulted from the Cu grids and carbon support film, respectively).
Fig. S2 (a) SEM image and (b) EDX spectrum of the Fe$_3$O$_4$/PbTiO$_3$ core/shell particles.

Fig. S3 (a) XRD pattern and (b) SEM image of Fe$_3$O$_4$ particles coated with weak crystalline PbTiO$_3$ layer synthesized at 140 °C for 4 h. SEM image and particle size distribution of γ-Fe$_2$O$_3$/PbTiO$_3$ core/shell particles after annealed in air at (c) and (d) 600 °C and (e) and (f) 700 °C for 2 h.
Table S1 Bulk density of the of pressed samples

<table>
<thead>
<tr>
<th>Samples</th>
<th>Fe$_3$O$_4$</th>
<th>γ-Fe$_2$O$_3$</th>
<th>Fe$_3$O$_4$/PbTiO$_3$</th>
<th>Fe$_3$O$_4$-PbTiO$_3$</th>
<th>γ-Fe$_2$O$_3$/PbTiO$_3$</th>
<th>γ-Fe$_2$O$_3$-PbTiO$_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk density (g/cm$^3$)</td>
<td>2.97</td>
<td>3.06</td>
<td>3.57</td>
<td>3.61</td>
<td>3.61</td>
<td>3.64</td>
</tr>
</tbody>
</table>

Fig. S4 TEM images of γ-Fe$_2$O$_3$/PbTiO$_3$ particles with different thickness of the shells: (a) 3 nm (0.6 g of Fe$_3$O$_4$ and 0.5 mmol of PbTiO$_3$) and (b) 8 nm (0.6 g of Fe$_3$O$_4$ and 1.5 mmol of PbTiO$_3$).

Fig. S5 (a) TEM image of the Fe$_3$O$_4$ particles with average diameter of 30 nm. (b) SEM image of γ-Fe$_2$O$_3$/PbTiO$_3$ core/shell nanochains. (c) and (d) TEM images of γ-Fe$_2$O$_3$/PbTiO$_3$ core/shell chains.
Fig. S6 (a) SEM images of CoFe$_2$O$_4$ particles prepared by hydrothermal method. The inset shows the grain size of the agglomerated elementary particles about 10 nm in average. (b) SEM images of the CoFe$_2$O$_4$ particles after heated in air at 600 °C for 2 h. The inset shows the grain size of the agglomerated elementary particles about 30 nm in average. (c) XRD pattern and (d) related EDX spectrum of CoFe$_2$O$_4$ particles prepared by hydrothermal method.

Fig. S7 EDS analysis of (a) and (b) Zr-hydroxide coated Fe$_3$O$_4$ particles, (c) and (d) Ti-hydroxide/Zr-hydroxide/Fe$_3$O$_4$ core/shell particles.
Fig. S8 XRD patterns of the Ferrite/perovskite oxide core/shell structures synthesized via the combined hydrothermal and annealing process: (a) CoFe$_2$O$_4$/BaTiO$_3$, (b) CoFe$_2$O$_4$/PbTiO$_3$, (c) CoFe$_2$O$_4$/Pb(Zr,Ti)O$_3$ and (d) γ-Fe$_2$O$_3$/Pb(Zr,Ti)O$_3$.

Fig. S9 EDX spectra of the Ferrite/perovskite oxide core/shell structures: (a) CoFe$_2$O$_4$/BaTiO$_3$, (b) CoFe$_2$O$_4$/PbTiO$_3$, (c) CoFe$_2$O$_4$/Pb(Zr,Ti)O$_3$ and (d) γ-Fe$_2$O$_3$/Pb(Zr,Ti)O$_3$. 