

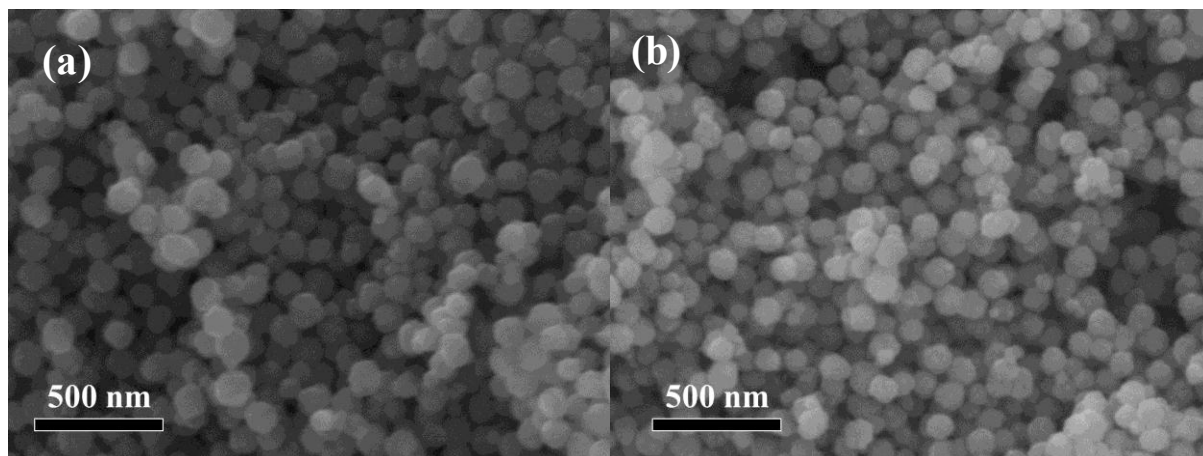
## Electronic Supplementary information

### **Multiple transition metal oxide mesoporous nanospheres with controllable composition for lithium storage**

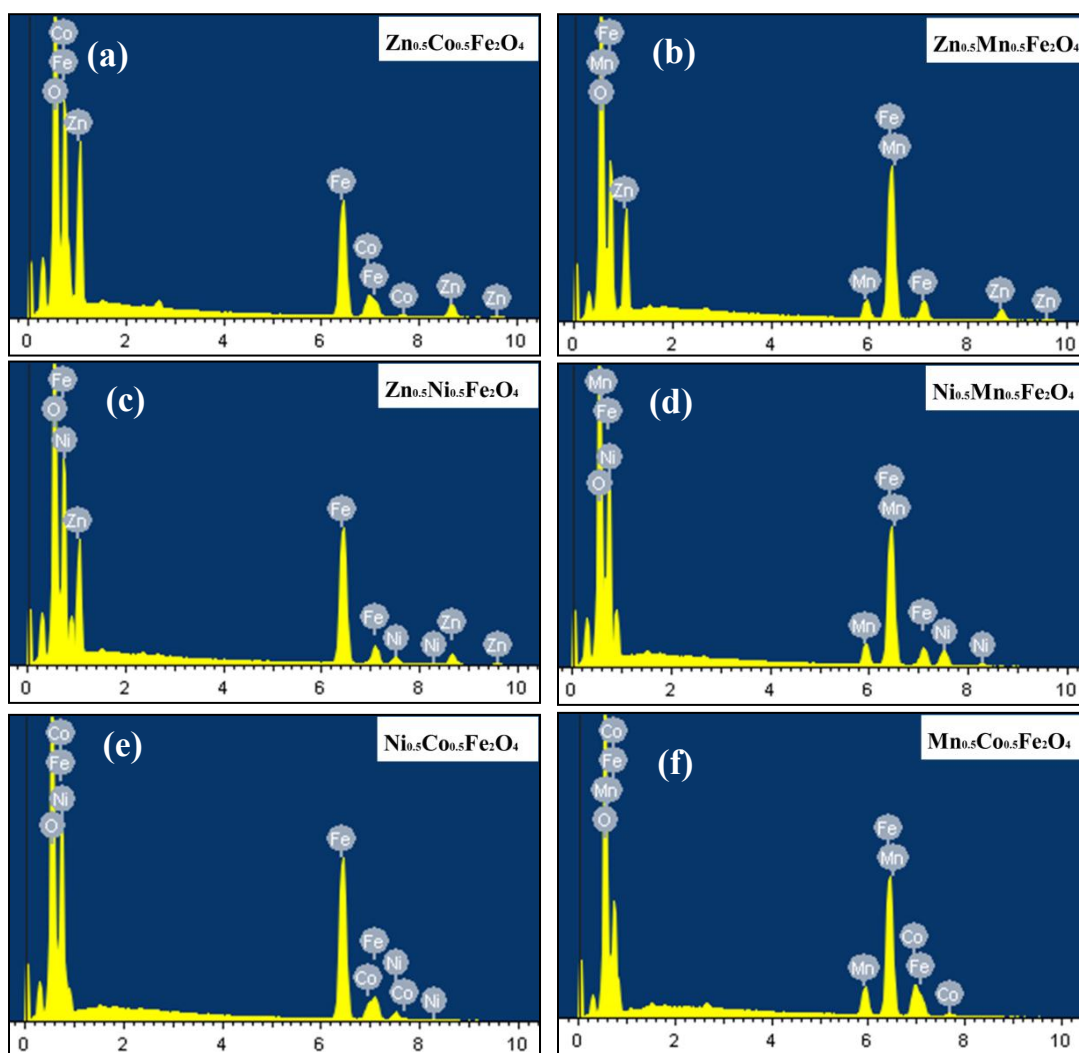
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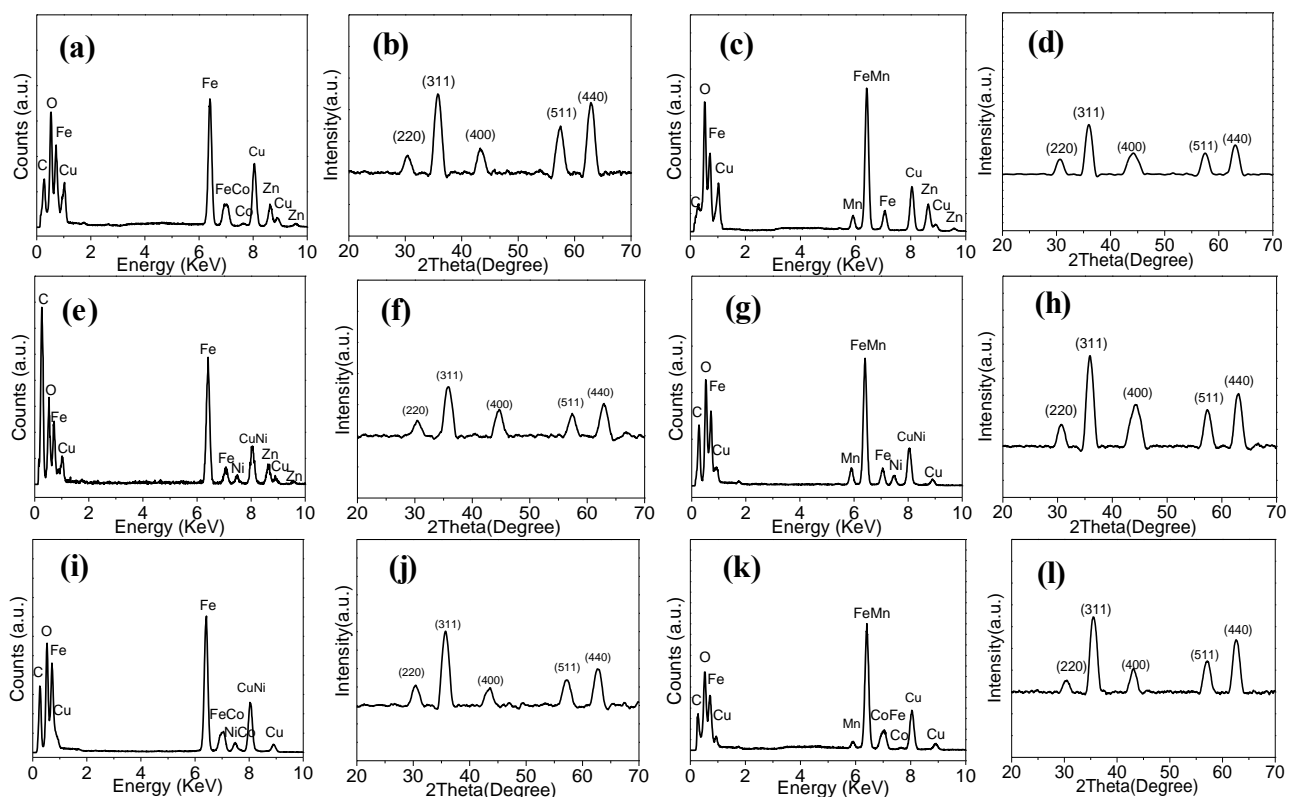
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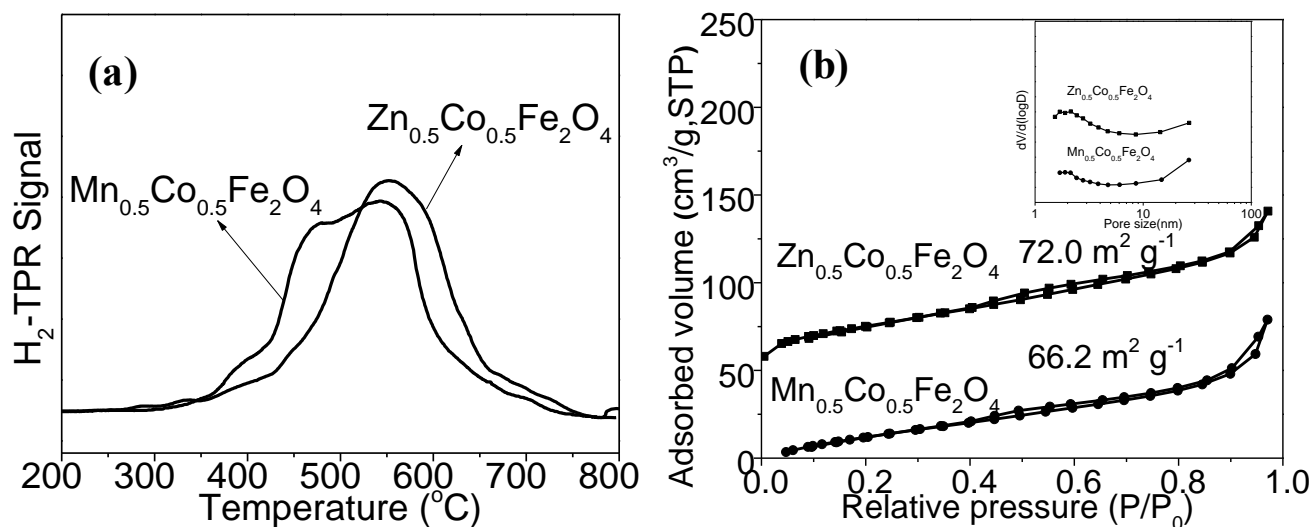
**Fig. S1** SEM images of  $\text{Zn}_{0.2}\text{Co}_{0.8}\text{Fe}_2\text{O}_4$  (a) and  $\text{Zn}_{0.8}\text{Co}_{0.2}\text{Fe}_2\text{O}_4$  (b).



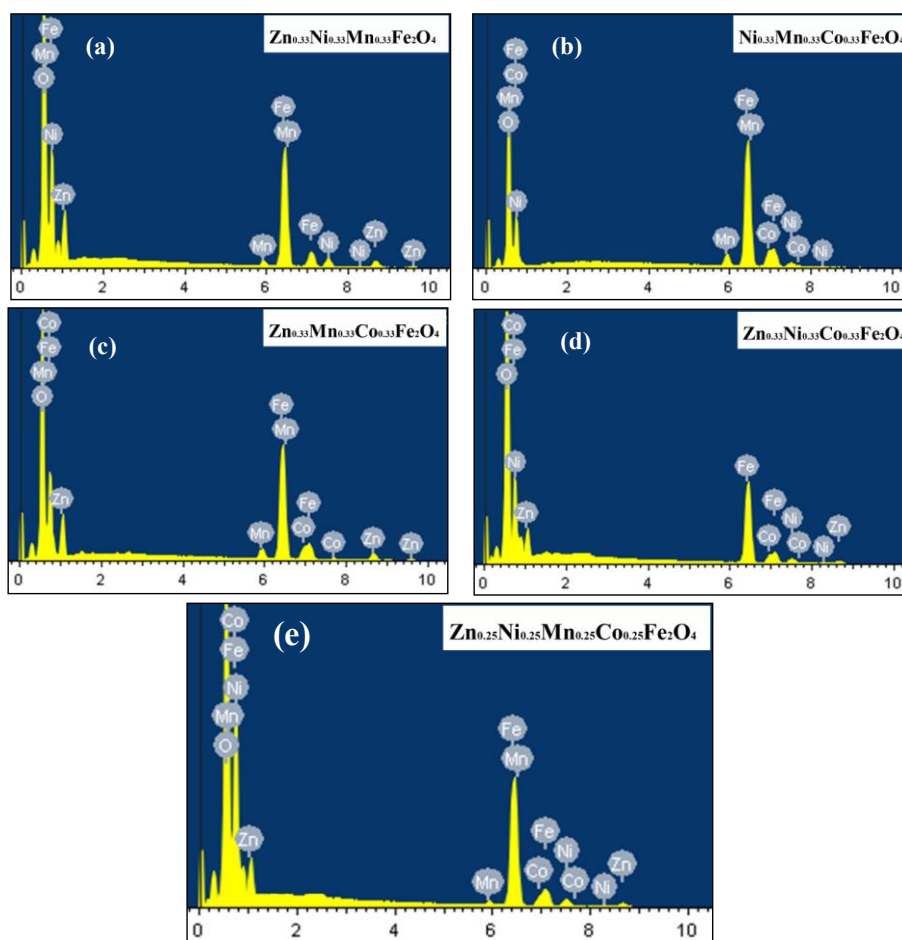
**Fig. S2** SEM-EDX spectra of the  $Zn_{0.5}Co_{0.5}Fe_2O_4$  (a),  $Zn_{0.5}Mn_{0.5}Fe_2O_4$  (b),  $Zn_{0.5}Ni_{0.5}Fe_2O_4$  (c),  $Ni_{0.5}Mn_{0.5}Fe_2O_4$  (d),  $Ni_{0.5}Co_{0.5}Fe_2O_4$  (e), and  $Mn_{0.5}Co_{0.5}Fe_2O_4$  (f).



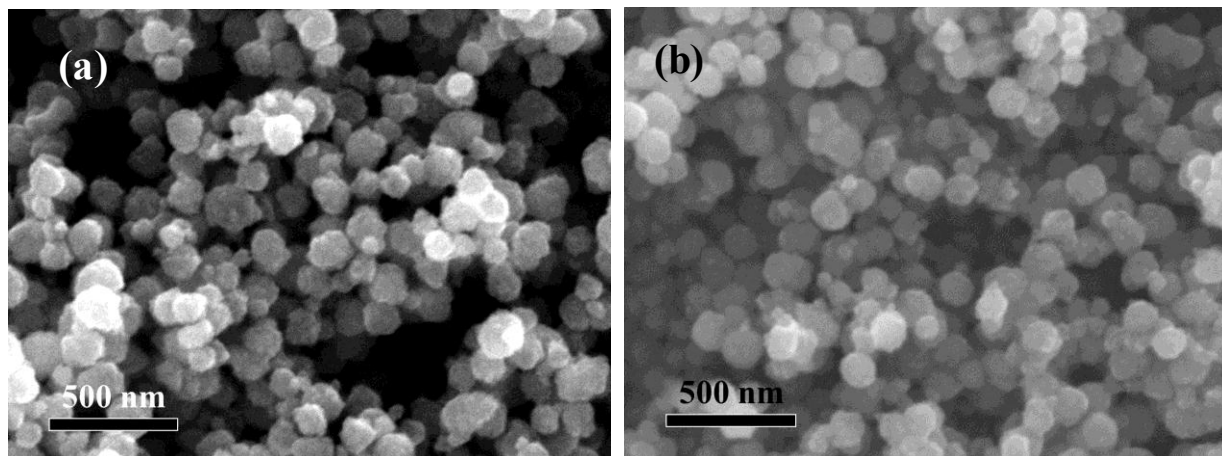
**Fig. S3** TEM-EDX spectra with single nanosphere (first and third column) and XRD patterns (second and fourth column) of the ternary Zn<sub>0.5</sub>Co<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> (a,b), Zn<sub>0.5</sub>Mn<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> (c,d), Zn<sub>0.5</sub>Ni<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> (e,f), Ni<sub>0.5</sub>Mn<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> (g,h), Ni<sub>0.5</sub>Co<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> (i,j), and Mn<sub>0.5</sub>Co<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> nanospheres (k,l).



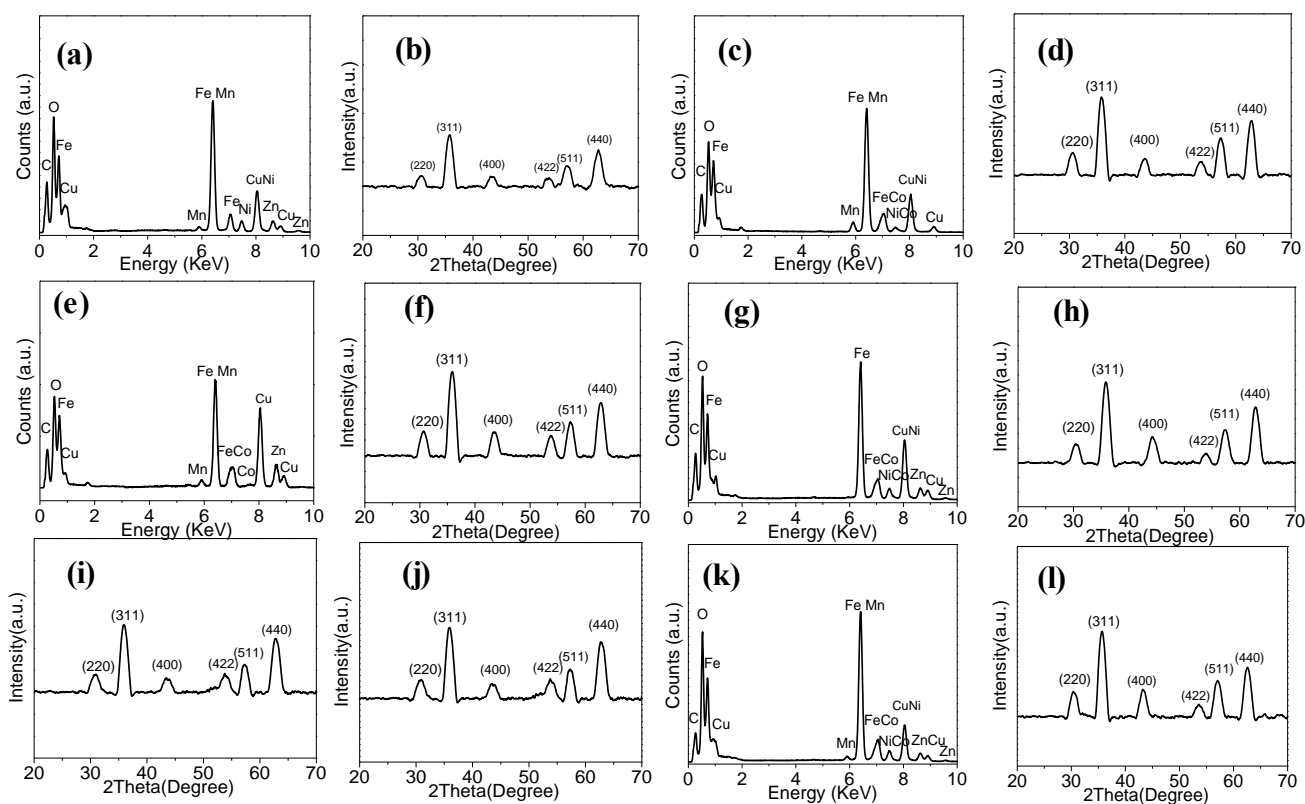
**Fig. S4** H<sub>2</sub>-TPR curves (a) and N<sub>2</sub> adsorption-desorption isotherms (b) (inset is their PSD curves) of Zn<sub>0.5</sub>Co<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> and Mn<sub>0.5</sub>Co<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> samples (For clarity, the isotherm of Zn<sub>0.5</sub>Co<sub>0.5</sub>Fe<sub>2</sub>O<sub>4</sub> was shifted for 60 cm<sup>3</sup> g<sup>-1</sup>).



**Fig. S5** SEM-EDX spectra of the  $\text{Zn}_{0.33}\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Fe}_2\text{O}_4$  (a),  $\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (b),  $\text{Zn}_{0.33}\text{Mn}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (c),  $\text{Zn}_{0.33}\text{Ni}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (d), and  $\text{Zn}_{0.25}\text{Ni}_{0.25}\text{Mn}_{0.25}\text{Co}_{0.25}\text{Fe}_2\text{O}_4$  (e).

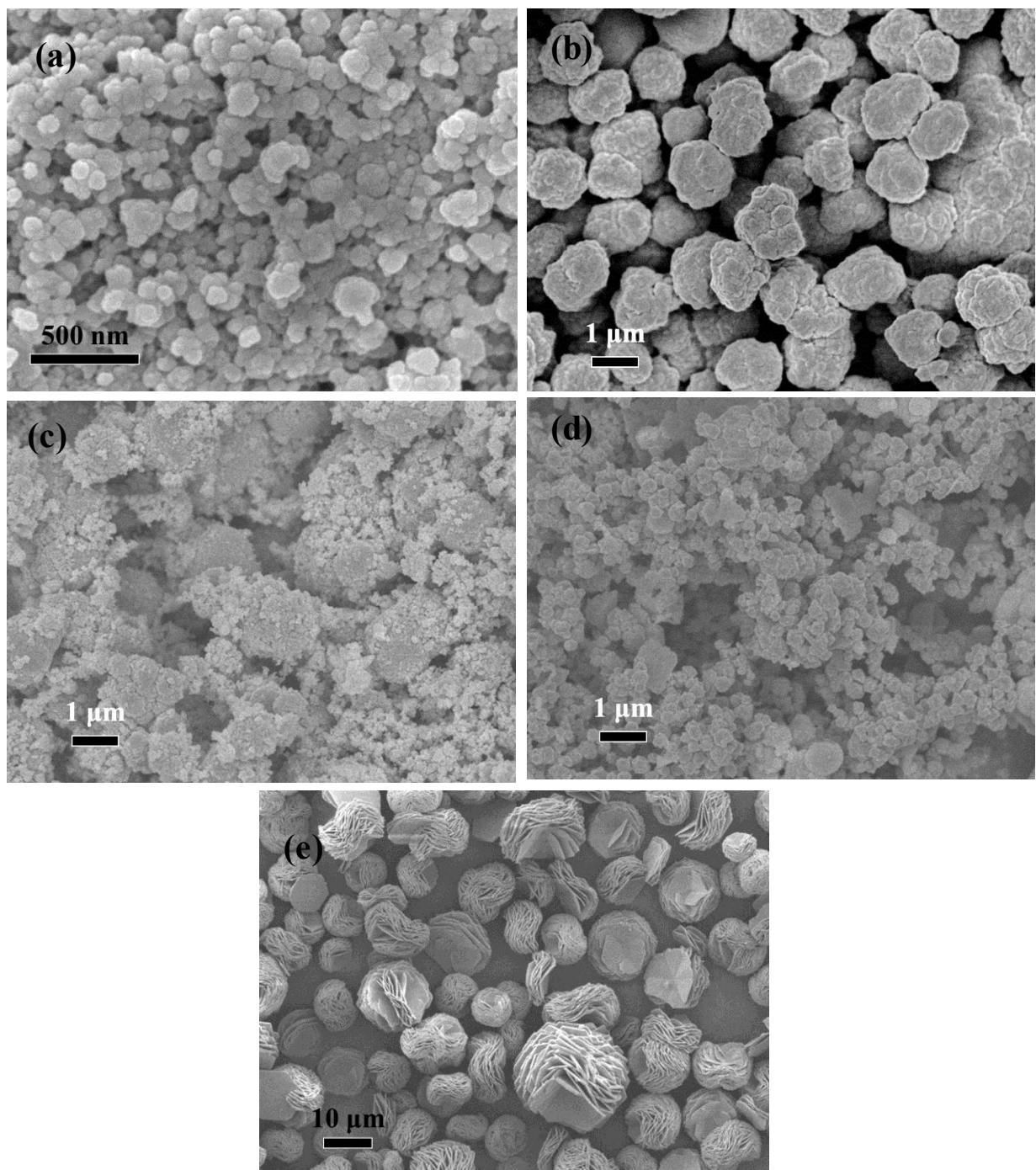


**Fig. S6** SEM images of  $\text{Zn}_{0.2}\text{Ni}_{0.4}\text{Mn}_{0.4}\text{Fe}_2\text{O}_4$  (a) and  $\text{Zn}_{0.4}\text{Ni}_{0.2}\text{Mn}_{0.4}\text{Fe}_2\text{O}_4$  (b).

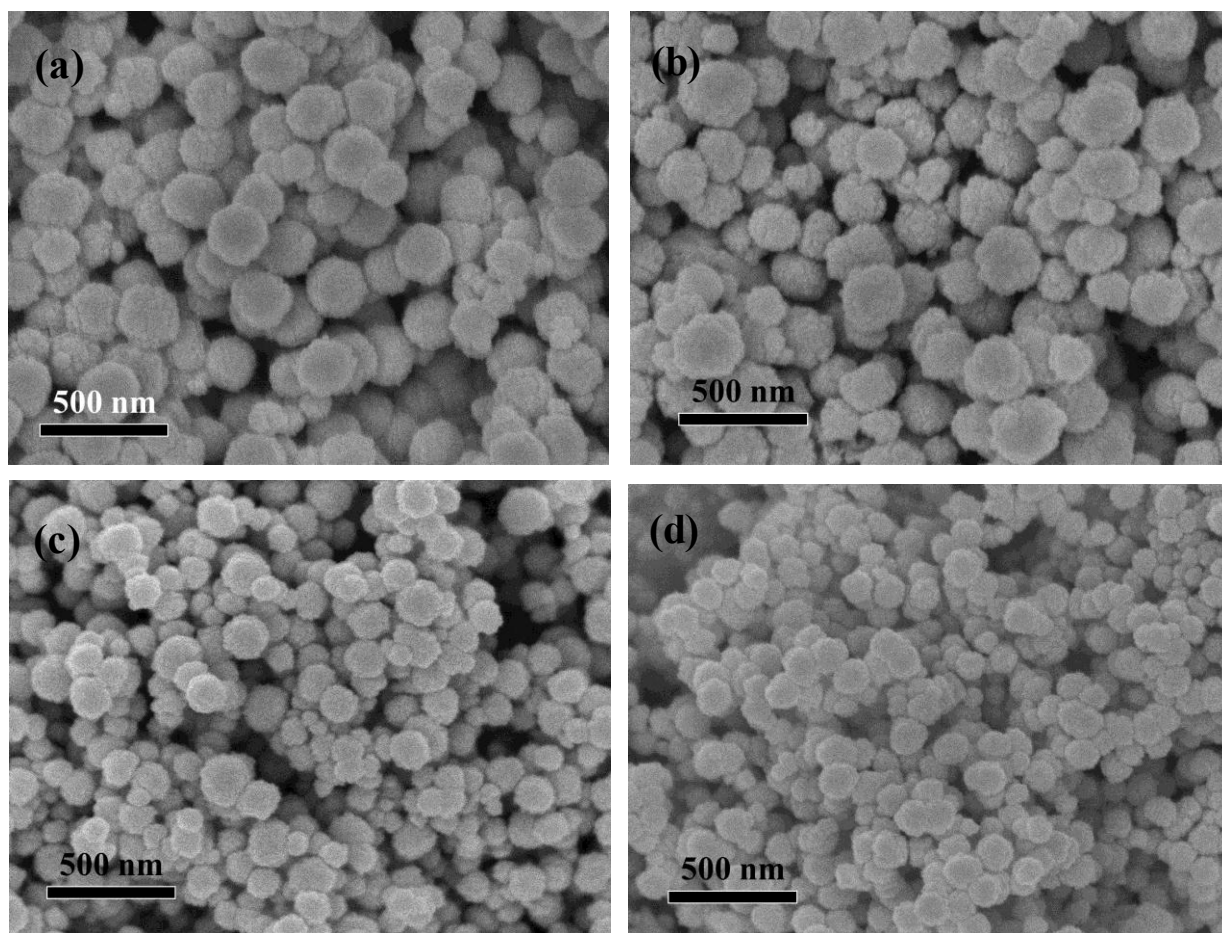


**Fig. S7** TEM-EDX spectra of a single nanosphere of the  $\text{Zn}_{0.33}\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Fe}_2\text{O}_4$  (a),  $\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (c),  $\text{Zn}_{0.33}\text{Mn}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (e),  $\text{Zn}_{0.33}\text{Ni}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (g),  $\text{Zn}_{0.25}\text{Ni}_{0.25}\text{Mn}_{0.25}\text{Co}_{0.25}\text{Fe}_2\text{O}_4$  (k), and XRD patterns of  $\text{Zn}_{0.33}\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Fe}_2\text{O}_4$  (b),  $\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (d),  $\text{Zn}_{0.33}\text{Mn}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (f),  $\text{Zn}_{0.33}\text{Ni}_{0.33}\text{Co}_{0.33}\text{Fe}_2\text{O}_4$  (h),  $\text{Zn}_{0.2}\text{Ni}_{0.4}\text{Mn}_{0.4}\text{Fe}_2\text{O}_4$  (i),  $\text{Zn}_{0.4}\text{Ni}_{0.2}\text{Mn}_{0.4}\text{Fe}_2\text{O}_4$  (j), and  $\text{Zn}_{0.25}\text{Ni}_{0.25}\text{Mn}_{0.25}\text{Co}_{0.25}\text{Fe}_2\text{O}_4$  (l).

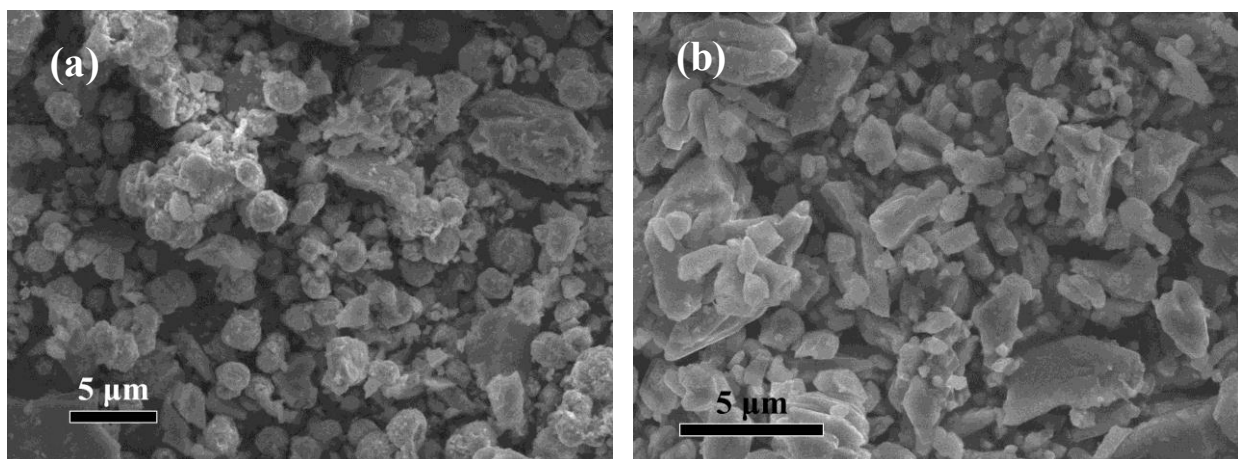




**Fig. S8** SEM images of the prepared Fe<sub>2</sub>O<sub>3</sub> (a), CoO (b), ZnO (c), NiO (d), and MnO (e) particles.

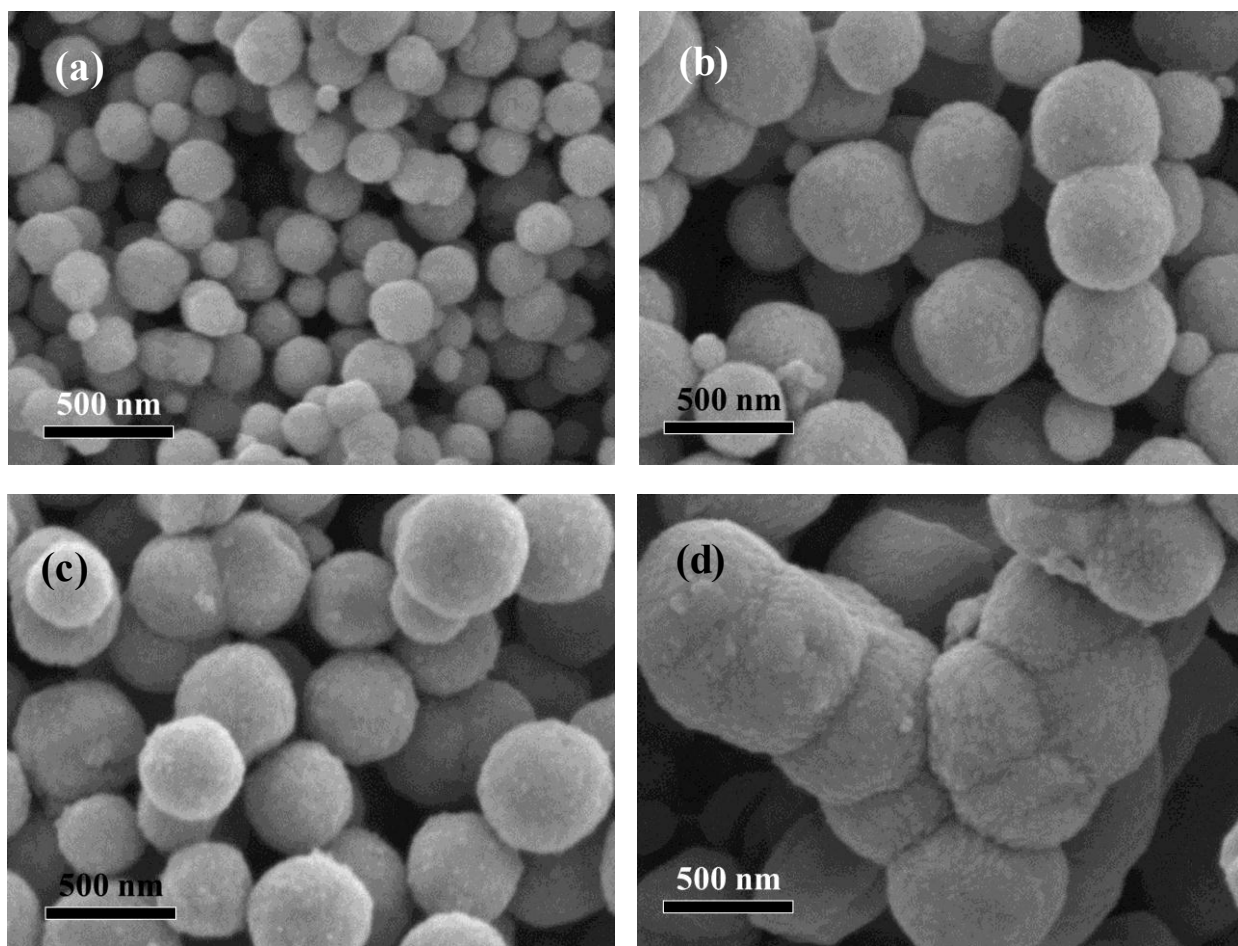


**Fig. S9** SEM images of the prepared CoFe<sub>2</sub>O<sub>4</sub> (a), NiFe<sub>2</sub>O<sub>4</sub> (b), MnFe<sub>2</sub>O<sub>4</sub> (c), and ZnFe<sub>2</sub>O<sub>4</sub> (d) nanospheres.

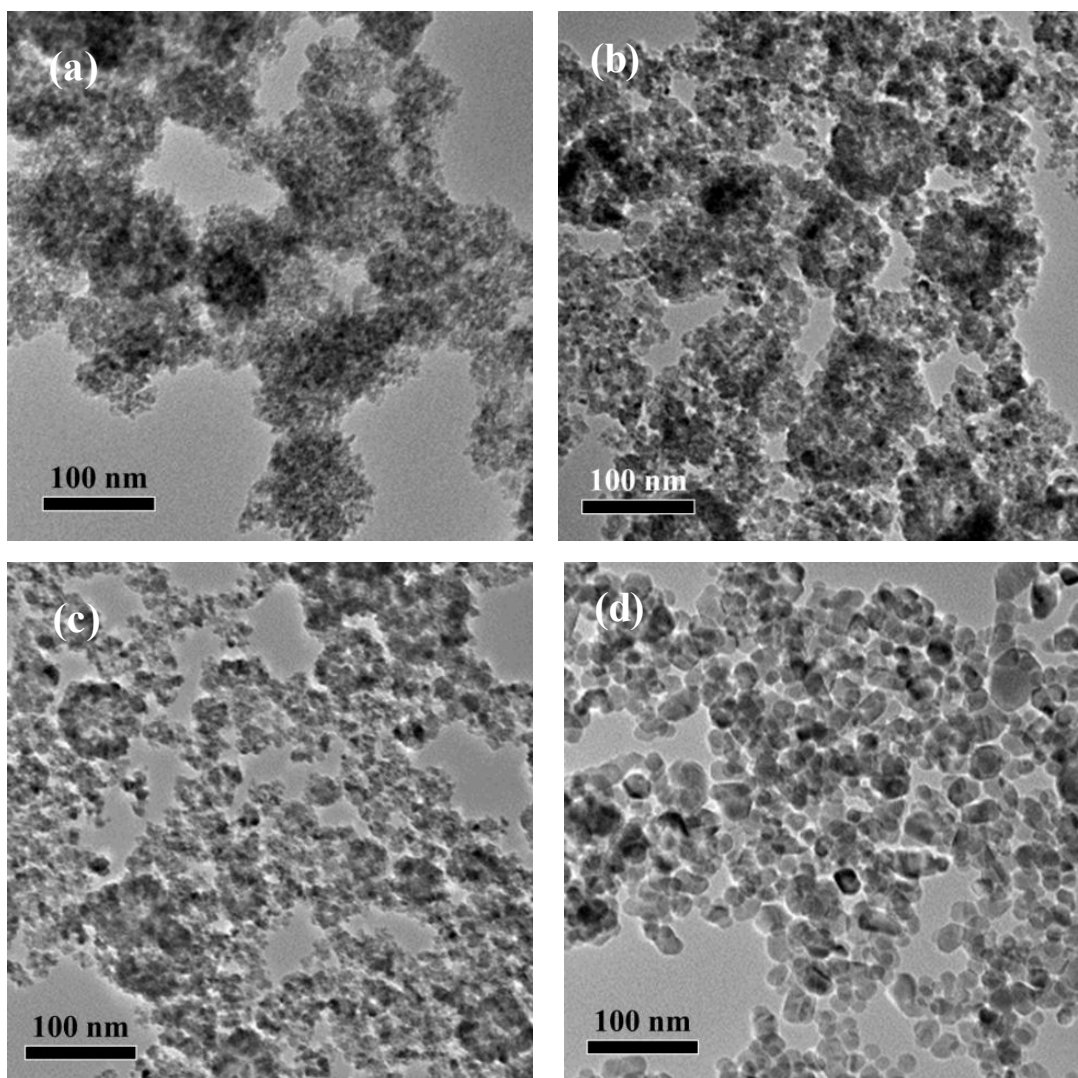


**Fig. S10** SEM images of the prepared  $\text{Zn}_{0.5}\text{Ni}_{0.5}\text{Mn}_2\text{O}_4$  (a) and  $\text{Zn}_{0.33}\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Co}_2\text{O}_4$  (b) particles.





**Fig. S11** SEM images of the prepared  $\text{Zn}_{0.5}\text{Co}_{0.5}\text{Fe}_2\text{O}_4$  particles by adding different mineralizer amount of  $\text{CH}_3\text{COONa}$  (a) 12 mmol, (b) 9 mmol, (c) 6 mmol, and (d) 3 mmol.



**Fig. S12** TEM images of prepared  $\text{Zn}_{0.5}\text{Co}_{0.5}\text{Fe}_2\text{O}_4$  particles at different volume ratio of glycol: water  
(a) 70:10, (b) 60:20, (c) 50:30, (d) 40:40.