

Fig. S1 TGA/DSC curves of the precursor of iron oxide and Co-B



Fig.S2 XRD patterns of the products obtained at different stage (a) iron oxide (b) iron oxide and Co-B (c) FeCo alloy and iron borate.



Fig. S3 XPS spectra of (a) B 1s; (b) O 1s; c) Co 2p; d) Fe 2p level for FeCo alloy and iron borate composites



Fig. S4 SEM images of FeCo alloy and iron borate obtained with different mol ratio of Fe to Co



Fig.S5 XRD patterns of the products obtained with different molar ratio of Co to Fe.



Fig. S6 SEM images of the FeCo alloy and iron borate obtained with mol ratio of Co to Fe of 6:7 with different heat treatment atmosphere (a: H<sub>2</sub> and N<sub>2</sub>, b: H<sub>2</sub> and Ar, and air)



Fig. S7 XRD patterns of the FeCo alloy and iron borate obtained (a) with mol ratio of Co to Fe of 6:7 with different heat treatment atmosphere (b) with mol ratio of Co to Fe of 7:7 with heat treatment atmosphere of  $H_2$  and  $N_2$ 



Fig. S8 SEM images of the FeCo alloy and iron borate composite nanorods with heat treatment time of 2h, (b) 3h, (c) 4h and (d) 5h.



Fig.S9 Schematic synthesis process of the FeCo alloy and iron borate composite nanorods



Fig. S11 Frequency dependences of the reflection loss (RL) for the composites or alloy synthesized without nanorod structure at thickness of (a) 1.5mm and (b) 2.5mm

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Fig. S12 The impedance matching degree  $\Delta$  of FeCo alloy and iron borate composite with homogeneously nanorods in different thickness(a) Co2 and (b) Co3