Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information for

Highly Stable Mesoporous Silica Nanospheres Embedded with FeCo/Graphitic Shell Nanocrystals as Magnetically Recyclable Multifunctional Adsorbents for Wastewater Treatment

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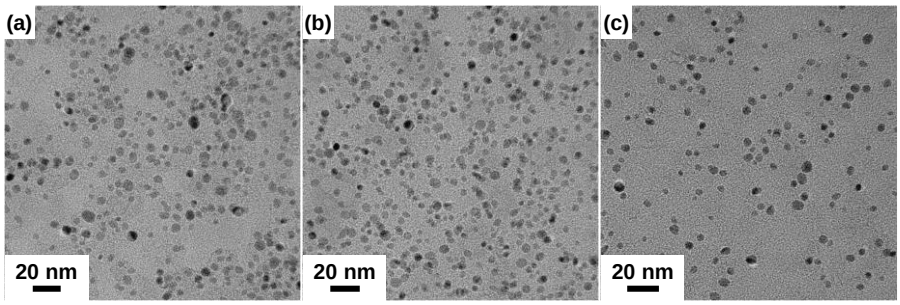

Fig. S1. TEM images of FeCo/GC NCs obtained from (a) 65 nm, (b) 130 nm, and (c) 270 nm FeCo/GC NCs@MSNs after HF treatment.

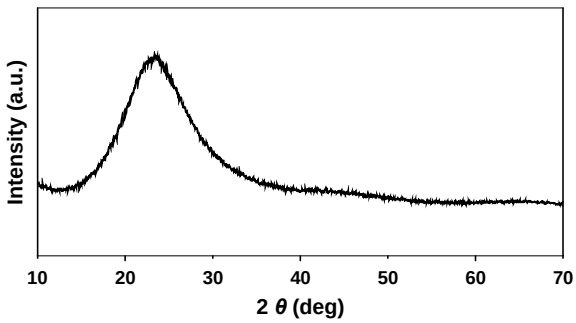

Fig. S2. XRD pattern of MSNs.

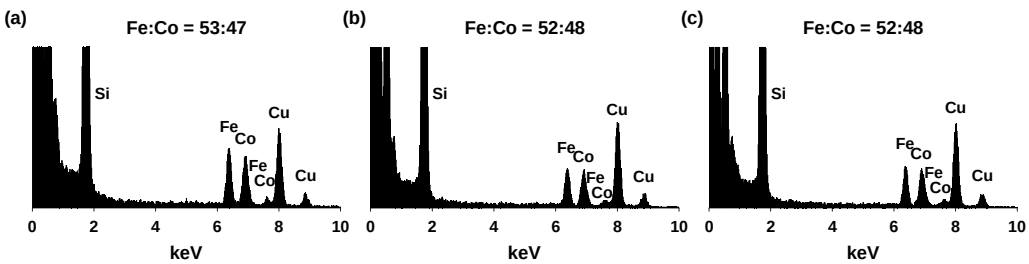

Fig. S3. EDX data of (a) 65 nm, (b) 130 nm, and (c) 270 nm FeCo/GC NCs@MSNs.

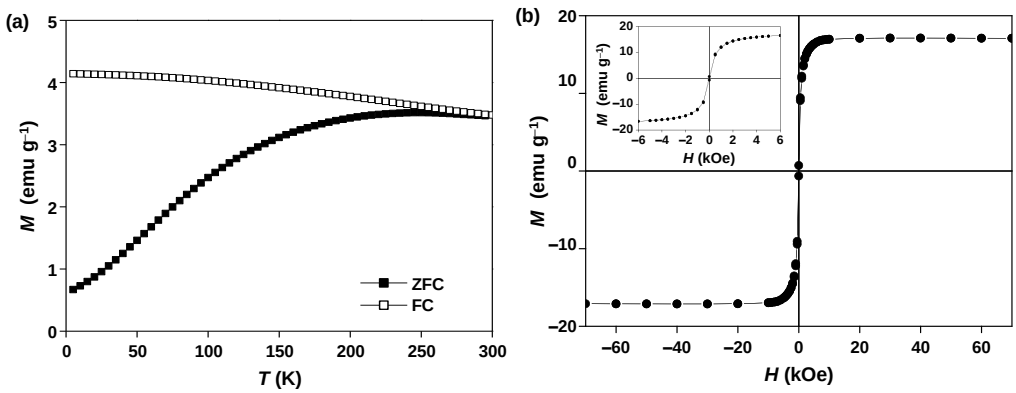

Fig. S4. (a) Temperature-dependent magnetization curves under an applied field of 100 Oe and (b) Field-dependent magnetization curves at 300 K for 130 nm FeCo/GC NCs@MSNs. Inset in (b) shows the loop on an enlarged x-axis scale.

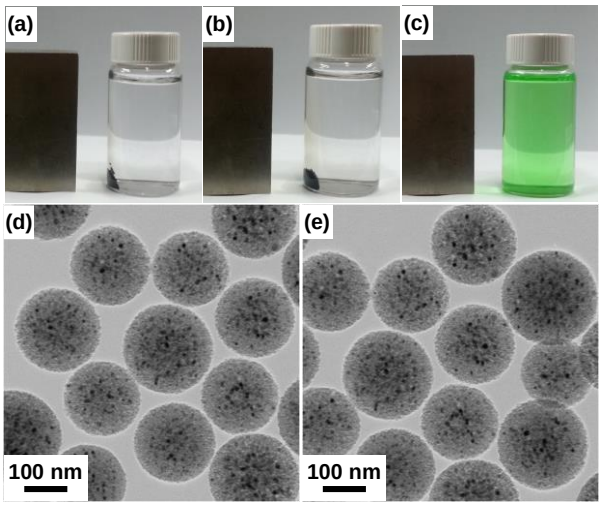

Fig. S5. Photographs of 130 nm (a, b) FeCo/GC NCs@MSNs-SH and (c) FeCo NCs@MSNs-SH in 35% HCl solutions (a, c) and a 1 mM NaOH (pH 11) solution (b). TEM images of FeCo/GC NCs@MSNs-SH stored over a monitoring period of a week in the (d) HCl and (e) NaOH solutions, respectively. FeCo/GC NCs@MSNs-SH exhibited stability against HCl or NaOH etching over a

monitoring period of a week. However, FeCo NCs@MSNs-SH having FeCo (being unencapsulated with a carbon shell) NCs turned the color to green in the HCl solution right after the addition due to the Fe and Co etching.

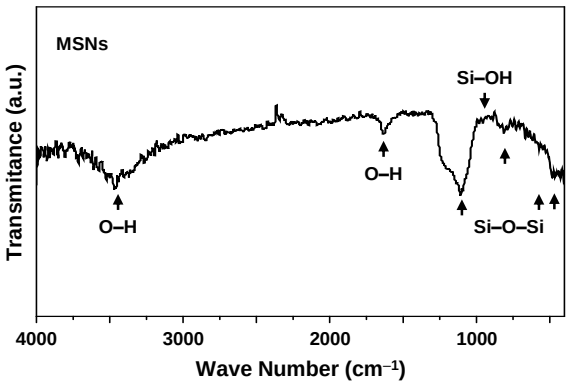

Fig. S6. FT-IR data of 130 nm MSNs.

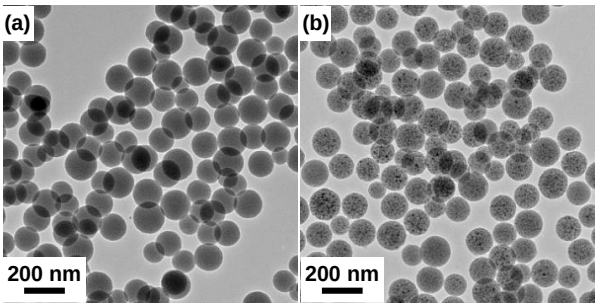

Fig. S7. TEM images of 130 nm (a) MSNs-SH and (b) FeCo/GC@MSNs-SH.

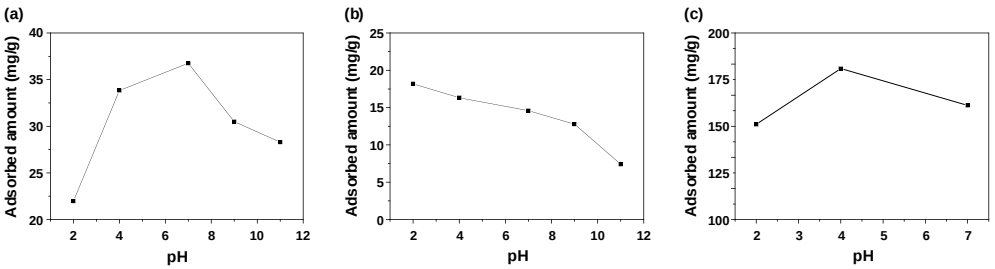

Fig. S8. Effect of pH on the adsorption of (a) MB, (b) MO, and (c) Hg^{2+} onto the FeCo/GC NCs@MSNs-SH.

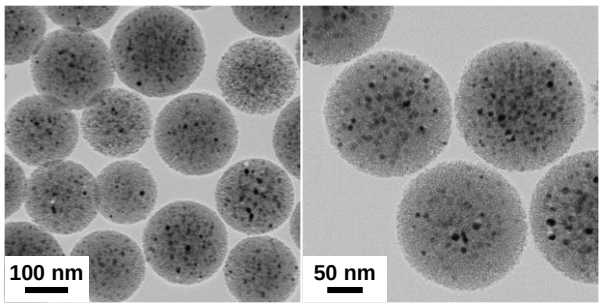

Fig. S9. TEM images of 130 nm FeCo/GC NCs@MSNs-SH after the six consecutive adsorption cycles for MO.

Table S1. Physicochemical properties of selected samples.

Sample	BET surface area (m^2/g)	Pore volume (cm^3/g)	pore size (nm)
MSNs	661	0.73	2.45
FeCo/GC NCs@MSNs	442	0.65	2.19

Table S2. Langmuir isotherm parameters for MB adsorption on various adsorbents.

Sample	Langmuir model		
	q_{max}	b	R^2
MSNs	20.33	1.54	0.99
FeCo/GC NCs@MSNs	28.99	2.97	0.99
FeCo/GC NCs@MSNs-SH	37.17	3.49	0.99

Table S3. Langmuir isotherm parameters for MO adsorption on various adsorbents.

Sample	Langmuir model		
	q_{max}	b	R^2
MSNs	3.33	0.38	0.97
FeCo/GC NCs@MSNs	13.39	0.48	0.98
FeCo/GC NCs@MSNs-SH	15.75	0.57	0.99

Table S4. Comparison of adsorption capacities of FeCo/GC NCs@MSNs-SH with different adsorbents.

Magnetic adsorbents for MB	q_e	***pH***	**References**
RGO–$MnFe_2O_4$ hybrid	34.7	–	S. Bai et al. (2012)[1]
Fe3O4@C	52.5	7.0	S. P. Wu et al. (2016)[2]
MMWCNT	11.9	7.0	J. L. Gong et al. (2009)[3]
M-MWCNTs	45.8	7.0	L. Ai et al. (2011)[4]
MGO	275.9	9.0	Y. F. Guo et al. (2016)[5]
CS/Mt-OREC	9.7	7.0	L. Zeng et al. (2015)[6]
ɤ-Fe_2O_3/C composites	193.4	–	J. Xiao et al. (2013)[7]
FeCo/GC NCs@MSNs-SH	36.8	7.0	This Study
Magnetic adsorbents for MO	q_e	***pH***	**References**
m-CS/c-Fe_2O_3/MWCNTs	61.4	–	H. Y. Zhu et al. (2010)[8]
CS/Mt-OREC	5.0	7.0	L. Zeng et al. (2015)[6]
CANF	102.0	4.0	B. Tanhaei et al. (2015)[9]
ɤ-Fe_2O_3/chitosan	28.5	2.9	R. Jiang et al. (2012)[10]
AC/$NiFe_2O_4$	93.5	3.0	T. Jiang et al. (2015)[11]
FeCo/GC NCs@MSNs-SH	14.6	7.0	This study
Magnetic adsorbents for Hg(II)	q_e	***pH***	**References**
MAF-SCMNPs	240.0	6.0	S. Bao et al. (2017)[12]
Fe_3O_4@$Cu_3(btc)_2$	158.2	6.0	F. Ke et al. (2017)[13]
Fe_3O_4@SiO_2–SH	148.8	6.5	S. Zhang et al. (2013)[14]
PR-MNPs	133	4.0	J. Song et al. (2011)[15]
CG-MCS	220.1	7.0	Y. Wang et al. (2013)[16]
AEPE-PS-MPs	28.7	7.0	K. Jainae et al. (2015)[17]
TETA-PGMA	468	6.0	Y. Wang et al. (2016)[18]
Thiol-functionalized MGO	30.9	–	J. Bao et al. (2013)[19]
HMSMCs	62.8	6.5	X. Zhang et al. (2015)[20]
MGO	59.9	6.0	Y. F. Guo et al. (2016)[5]
rGO-Fe(0)-Fe_3O_4	22.0	7.0	P. Bhunia et al. (2012)[21]
FeCo/GC NCs@MSNs-SH	221.4	4.0	This study

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