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Support information for

Excellent fluoride removal properties of porous hollow MgO microspheres

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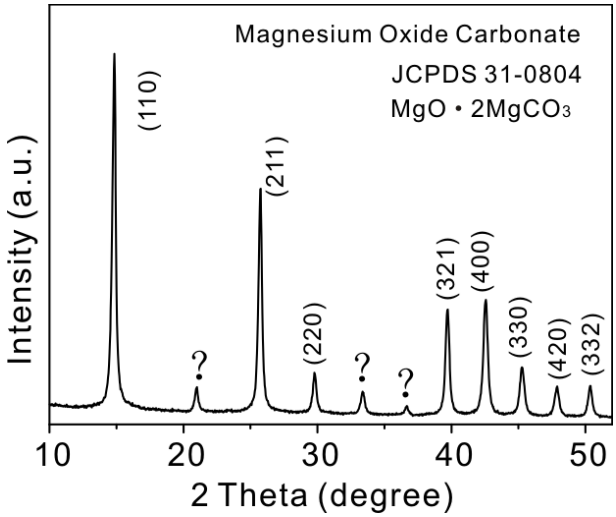

Fig. S1. XRD pattern of the obtained precursor of MgO.

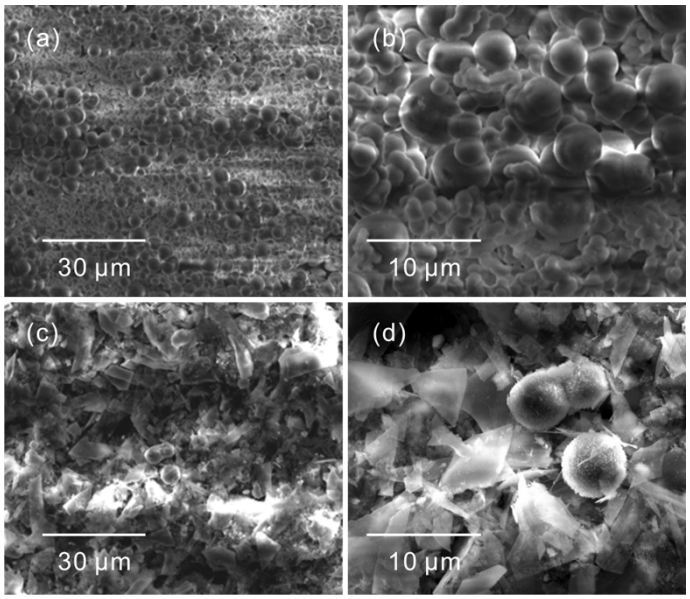

Fig. S2. SEM images of the obtained precursors synthesized with different volume ratio of EG and water. (a, b) 75:25, (c, d) 25:75.

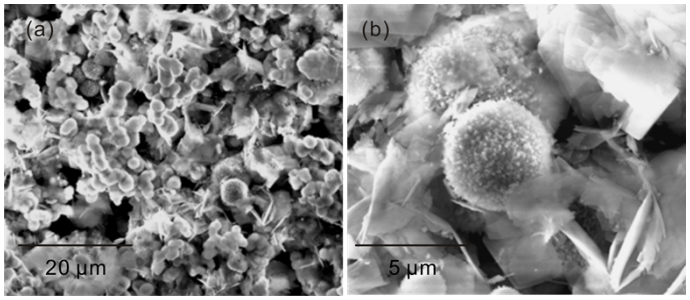

Fig. S3. SEM images of the obtained precursor synthesized at 140 ºC.

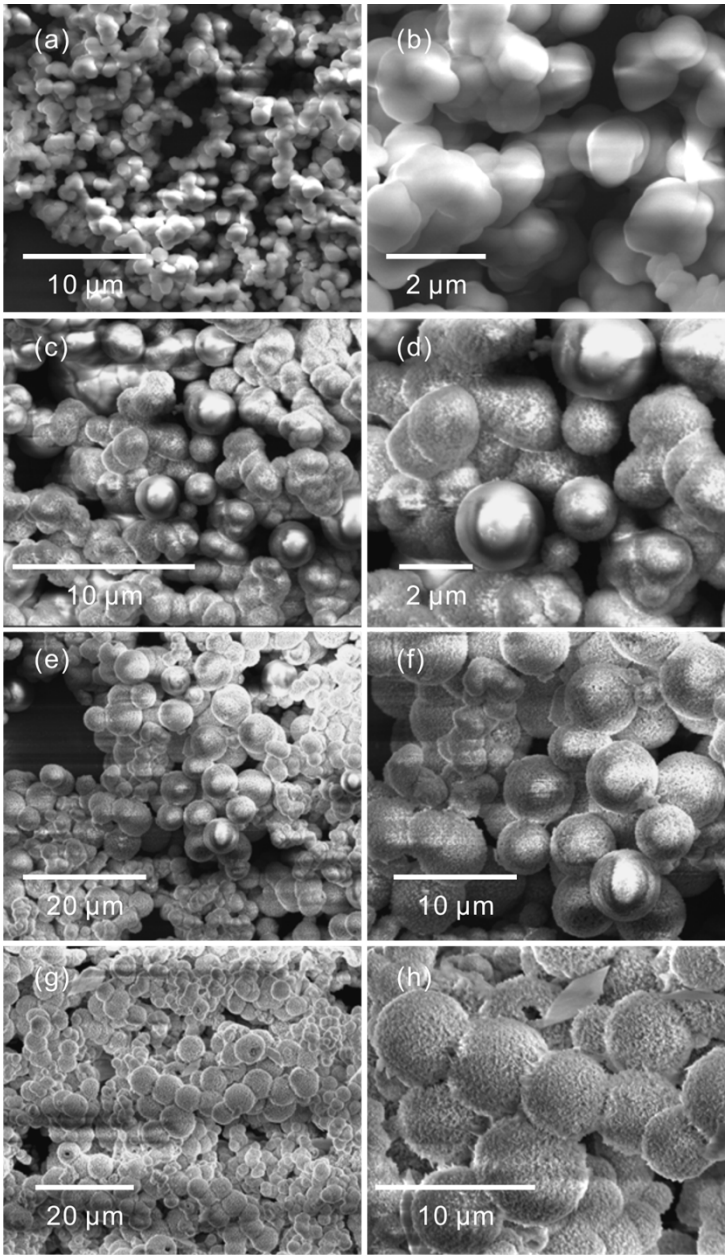

Fig. S4. SEM images of the intermediate products prepared at reaction times of 2 hours (a, b), 3 hours (c, d), 5 hours (e, f) and 7 hours (g, h).

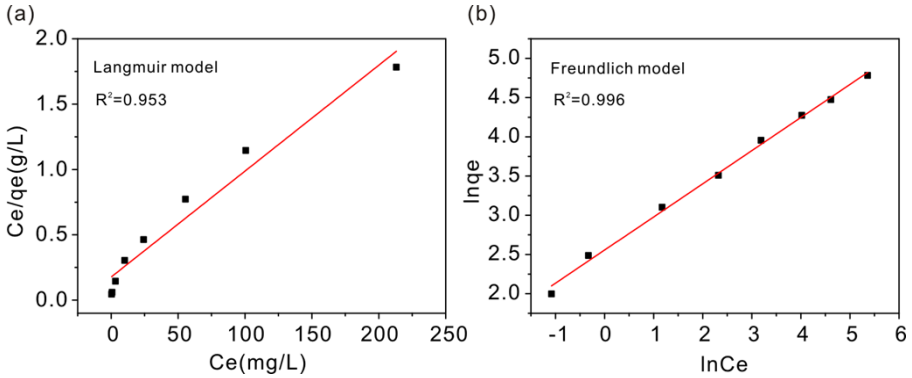

Fig. S5. Linearized Langmuir (a) and Freundlich (b) isotherm obtained from fluoride adsorption on porous MgO microspheres.

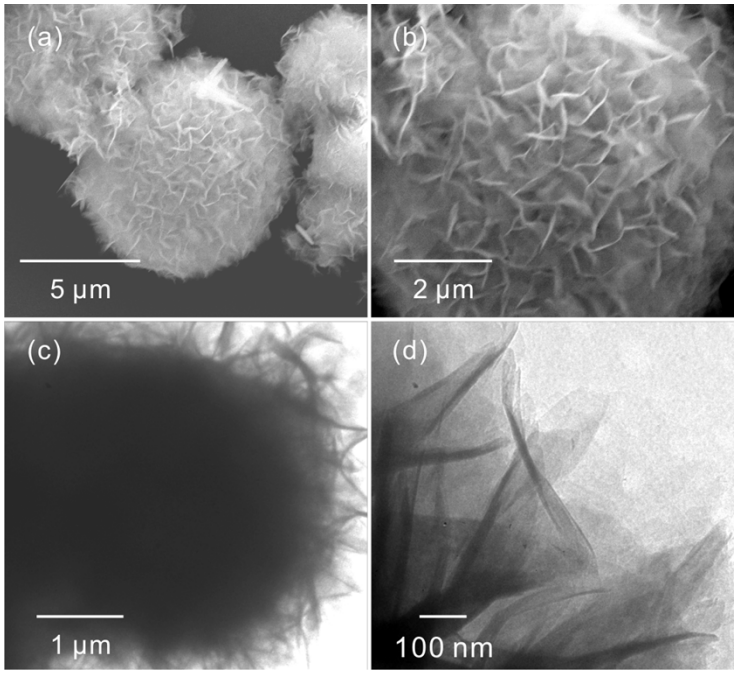

Fig. S6. SEM (a, b) and TEM (c, d) images of the porous hollow MgO microspheres after immersion in water for 24 hours.

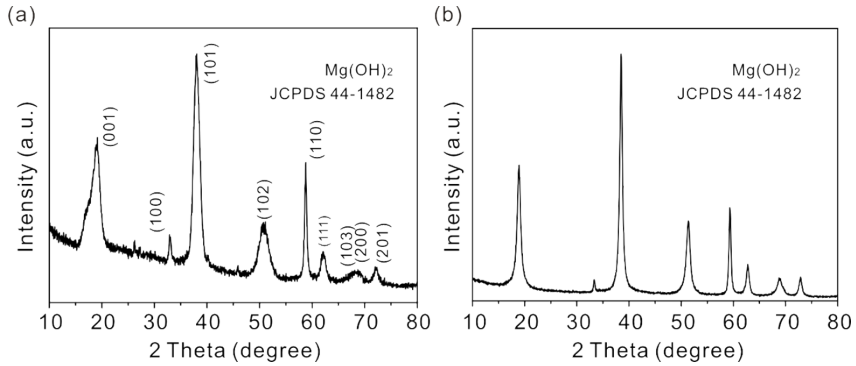

Fig. S7. XRD pattern of the porous hollow MgO microspheres after immersion in water for 24 hours (a), and after fluoride removal (b).

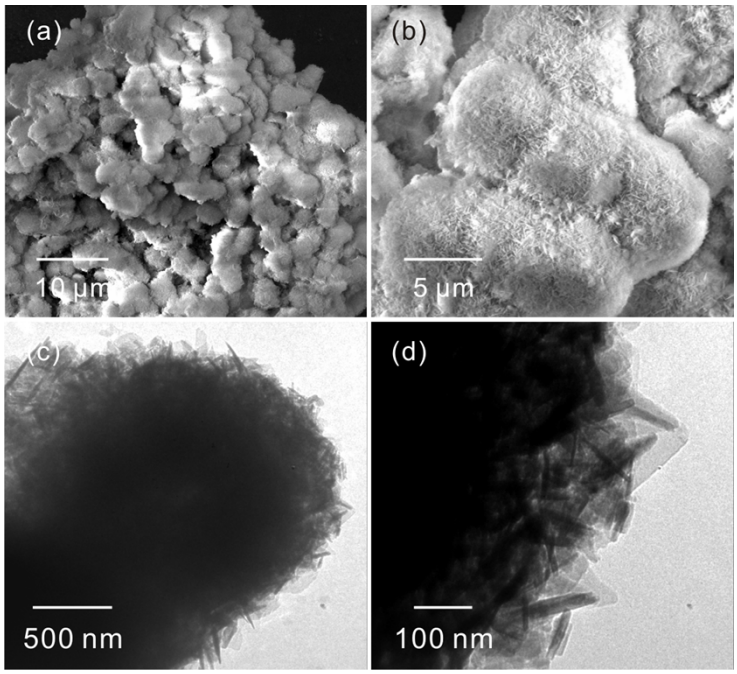

Fig. S8. SEM (a, b) and TEM (c, d) images of the porous hollow MgO microspheres after fluoride adsorption.

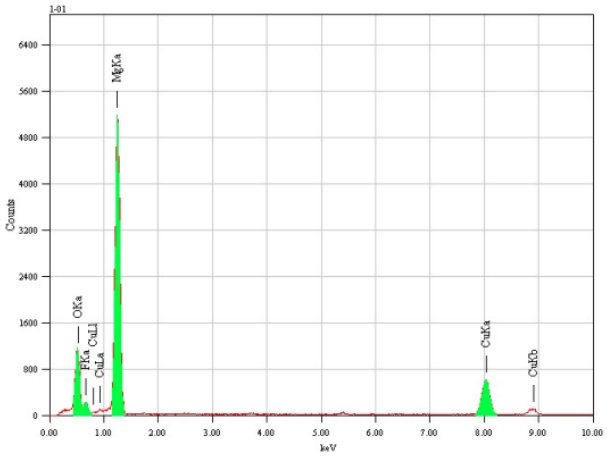

Fig. S9. TEM-EDS spectrum of the porous hollow MgO microspheres after fluoride adsorption.

Table S1. Kinetics parameters for fluoride adsorption on porous hollow MgO microspheres.

		First-order kinetics			Second-order kinetics		
Equations		$\ln(q_e - q_t) = \ln q_e - k_1 t$			$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e}$		
C_o (mg/L)	$q_{e,exp}$ (mg/g)	k_1 (1/min)	$q_{e,cal}$ (mg/g)	R^2	k_2 (g/(mg·min))	$q_{e,cal}$ (mg/g)	R^2
10	9.69	1.6×10^{-2}	20.68	0.647	0.12	9.71	0.999

Note: k_1 is the adsorption rate constant for pseudo-first order reaction (1/min). k_2 is the rate constant for pseudo-second order reaction (g/(mg·min)). q_e and q_t are the amounts of solute sorbed at equilibrium and at any time t (mg/g), respectively. $q_{e,exp}$ is the adsorption capacity evaluated from batch experiment, while $q_{e,cal}$ is the adsorption capacity calculated on the basis of the pseudo-first-order and pseudo-second-order equations.

Table S2. Langmuir and Freundlich adsorption isotherm parameters for fluoride on porous hollow MgO microspheres.

Equations	Langmuir model $\frac{C_e}{q_e}=\frac{C_e}{q_m}+\frac{1}{q_m k_L}$			Freundlich model $\ln q_e=\frac{1}{n}\ln C_e+\ln k$		
Parameters	K_L(L/mg)	q_m (mg/g)	R^2	n	k	R^2
Values	0.046	123.30	0.953	2.37	12.88	0.996

Note: C_e is the equilibrium concentration of fluoride (mg/L); q_e is the amount of fluoride adsorbed on per weight of adsorbent after equilibrium (mg/g); q_m represents the maximum adsorption capacity of fluoride on per weight of adsorbent (mg/g); k_L is the Langmuir constant related to the energy of adsorption (L/mg); q_m and k_L were calculated from the slope and intercept of the linear plots of C_e/q_e vs C_e. The Freundlich constant k is correlated to the relative adsorption capacity of the adsorbent (mg/g), and 1/n is the adsorption intensity.