Electronic Supplementary Information (ESI) for

Ordered mesoporous MnO_2 nanoarrays as synergetic adsorbent for effective arsenic(III) removal

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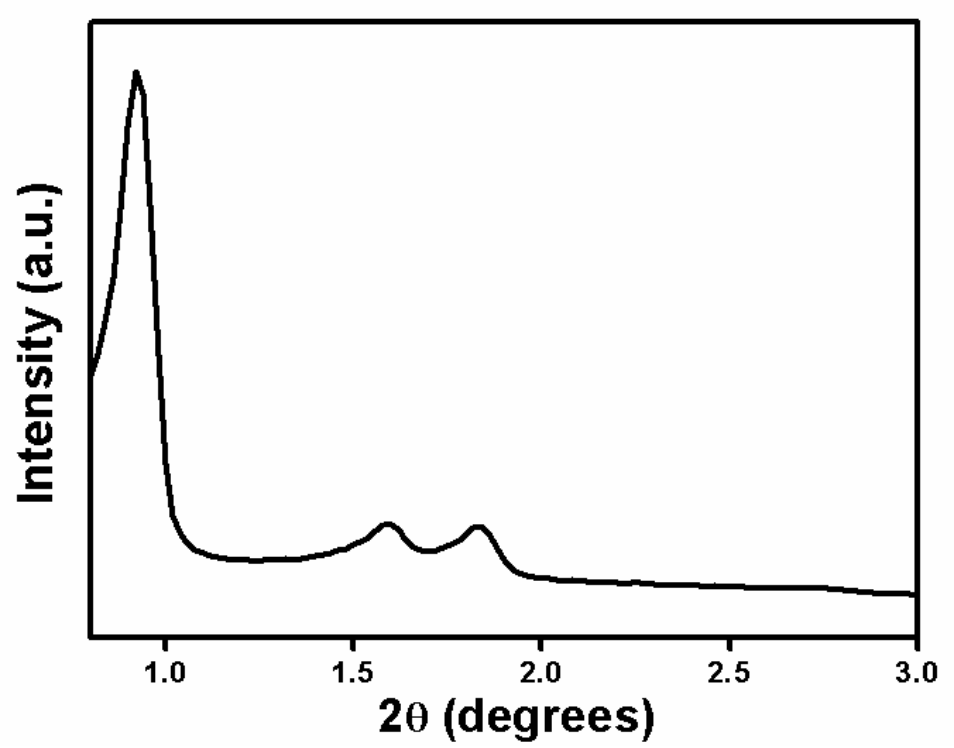

Fig. S1 The SAXRD pattern of SBA-15 silica template.

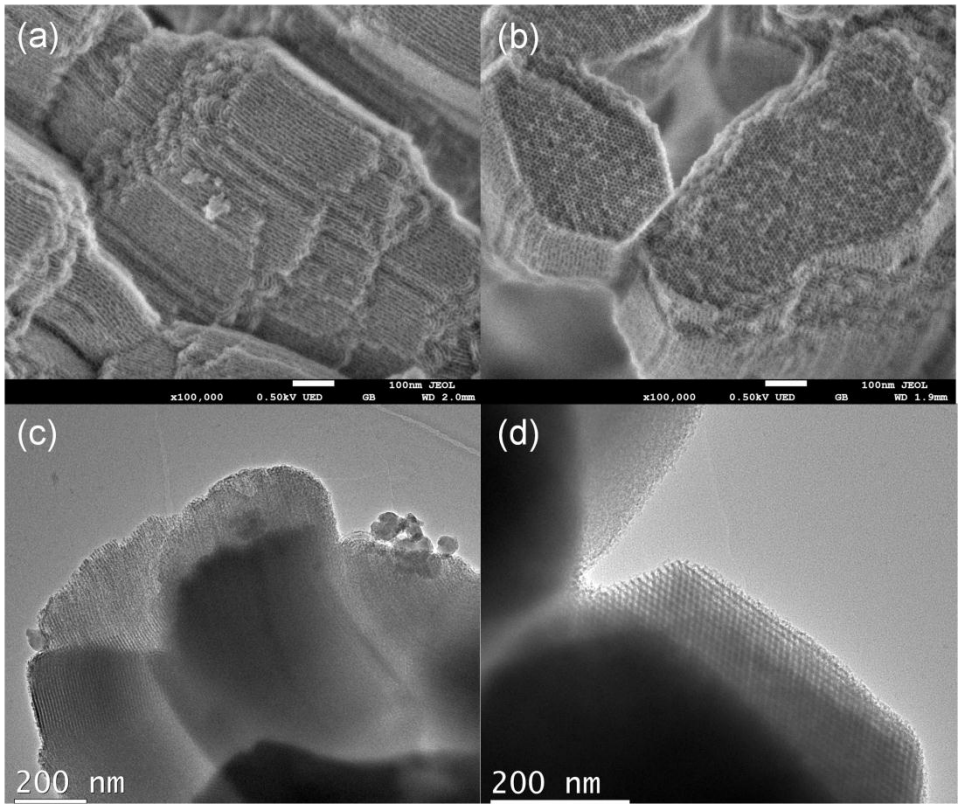

Fig. S2 (a, b) HRSEM and (c, d) TEM images of SBA-15 silica template.

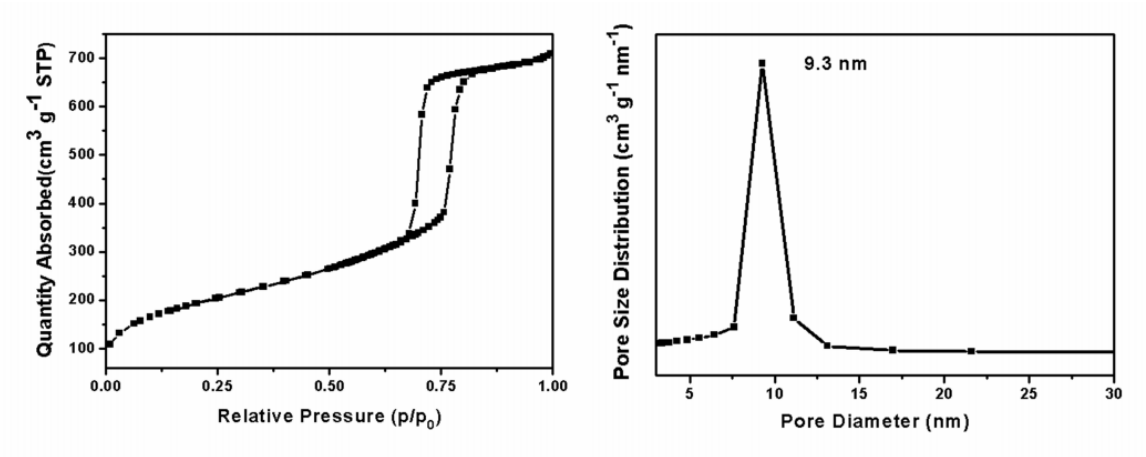

Fig. S3 (a) Nitrogen adsorption-desorption isotherm and (b) corresponding pore size distribution for SBA-15 silica template according to BJH method.

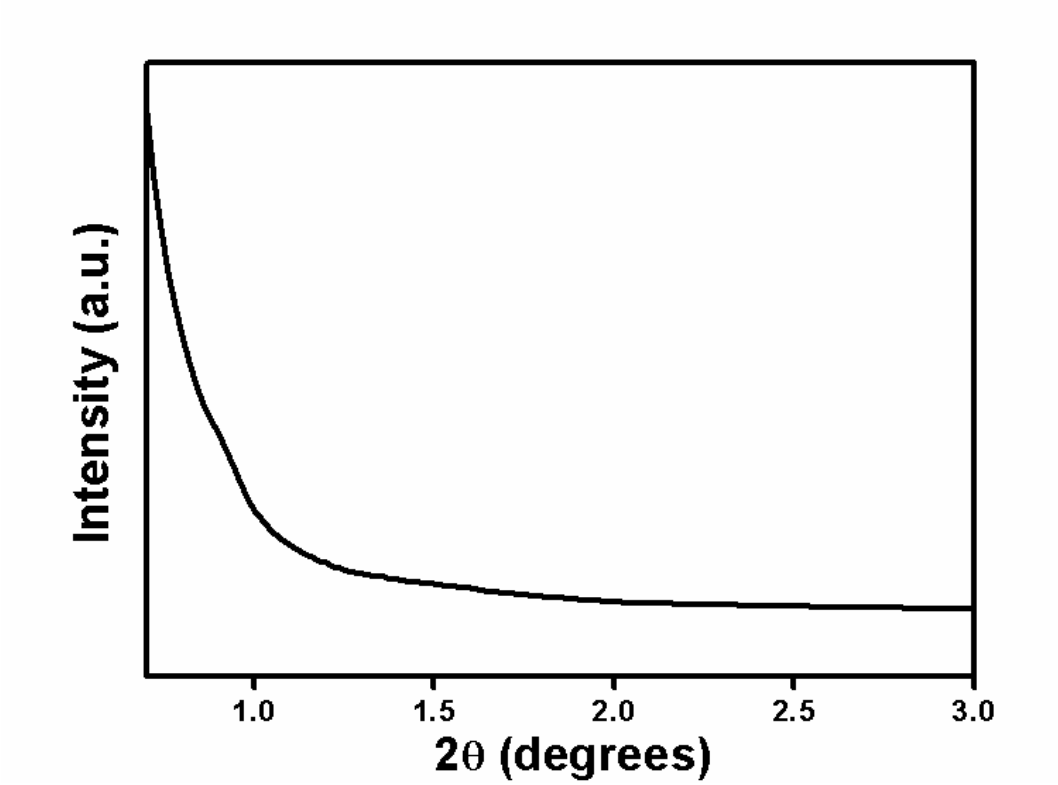

Fig. S4 MnO_2 prepared without the aid of vacuum

Table. S1 Physical Properties of SBA-15, meso-MnO_2 and synergetic adsorbents.

	Pore size distribution (nm)	Surface area (m^2 g^{-1})	Pore volume (cm^3 g^{-1})
SBA-15	9.27	689.7	1.03
meso-MnO_2	3.11	139.2	0.28
FeMn-1	3.08	89.8	0.24
FeMn-2	3.02	81.9	0.22
FeMn-3	2.82	75.4	0.20
FeMn-4	2.72	69.2	0.18

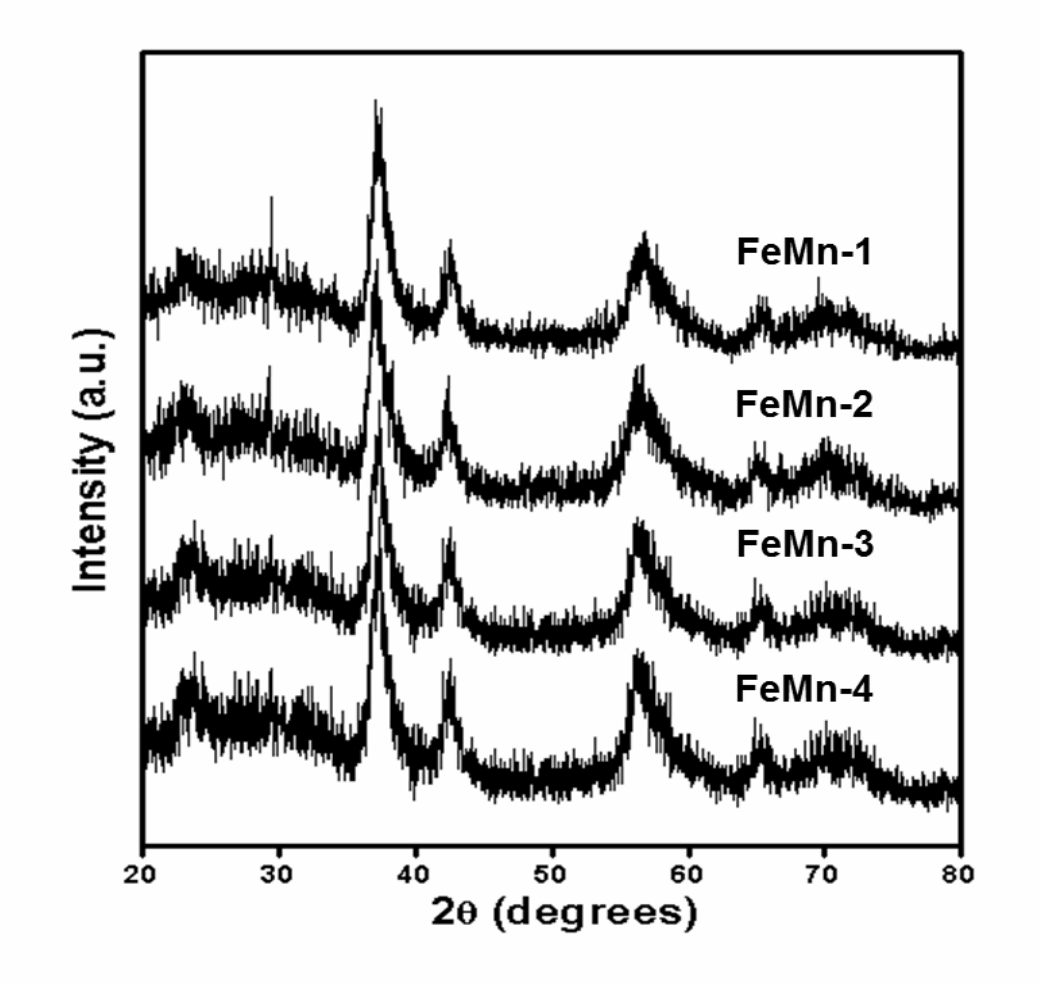

Fig. S5 The XRD patterns of adsorbents FeMn-x series adsorbents

In order to investigate the adsorption type and describe the relationship between the adsorbent and adsorbate, the Langmuir (Eq. S1) and Freundlich (Eq. S2) were used.

$$Q_e = \frac{bQ_mC_e}{1 + bC_e} \quad \text{(S1)}$$

$$Q_e = kC_e^{(1/n)} \quad \text{(S2)}$$

where Q_e is the amount of arsenic adsorbed on the solid phase (mg/g), C_e the equilibrium concentration in solution phase (mg/L); Q_m (mg/g) the maximum adsorption capacity, and b (L/mg) Langmuir constants related to energy of adsorption. The k (mg/g) and n for the Freundlich constants associated with the adsorption capacity and heterogeneity factor, respectively. The constants of Langmuir and Freundlich isotherms are presented in Table S2.

Table S2. The isotherm parameters for As adsorption of the synergetic adsorbent FeMn-2

Arsenic Species	Langmuir model			Freundlich model		
	Q_m (mg/g)	b (L/mg)	R^2	k (mg/g)	n	R^2
As(Ⅲ)	10.55	1.895	0.988	6.092	5.942	0.974

Adsorption kinetic study was performed to calculate the reaction rate between the arsenic anion and adsorbent. Pseudo-first order (Eq. S3) and pseudo-second order (Eq. S4) models were applied to analyze the kinetics of arsenic adsorption as follows.

$$Q_t = Q_e(1 - e^{-k_1 t}) \quad \text{(S3)}$$

$$Q_t = \frac{tk_2{Q_e}^2}{1 + k_2Q_et} \quad \text{(S4)}$$

where k_1 (min^{-1}) and k_2 (g mg^{-1} min^{-1}) are the pseudo-first order and pseudo-second order rate constants, respectively; Q_t and Q_e the amount of arsenic adsorbed at any time (mg g^{-1}) and equilibrium adsorption capacity, and t (min) the reaction time. The kinetic parameters of pseudo-first order and pseudo-second order models estimated for the adsorption are shown in Table S3.

Table S3. The kinetic parameters of As adsorption of the synergetic adsorbent FeMn-2

Arsenic Species	Pseudo-first-order model			Pseudo-second-order model		
	k_1 (min^{-1})	Q_e (mg g^{-1})	R^2	k_2 (g mg^{-1} min^{-1})	Q_e(mg g^{-1})	R^2
As(Ⅲ)	0.182	0.192	0.779	1.574	0.203	0.973