Supporting information

1. Glossary

Symbols and the corresponding units in this work:

C^{av} the statistically average concentration of the analyte in mesopore channel, mol/cm^3

q the statistically average concentration of the analyte in macropore channel, mol/cm^3

C_0^b the concentration of target species under the saturated vapor pressure, mol/cm^3

D_{pore} diffusion coefficient inside the pore, cm^2/s

L the half average length of the tube, cm

r_{pore} the inner radius of mesopore, cm

R the diameter of the used colloidal particle, cm

H the film thickness, cm

Γ_{site} the surface concentration of binding sites decorating the mesopore wall, mol/cm^2

$f(y)$ the distribution function of binding sites inside the pore wall surface

k_{ads} adsorption rate constant, cm^3/mol/s

k_{des} desorption rate constant, s^{-1}

$k_{app-ads}$ the apparent adsorption rate constant, cm^3/mol/s

$k_{app-des}$ the apparent desorption rate constant, s^{-1}

K_{des} desorption equilibrium constant, cm^3/mol

ρ , φ the regulatory factors to describe the molecular imprinting efficiency

y normalized nanopore axial coordinate

t time, s

θ the local pore wall coverage

β the ratio between the molecule and nanopore size

2. The average length of nanotube in macro-mesoporous film

When the diameter of mesopore is *r*, the diameter of the equivalent sphere is *R*, and the thickness of wall is *d*, in the cross-section of the equivalent sphere, the number of the tube is:

$$N = \frac{R-d}{r+d}$$

When the number of *N* is odd, the length of tube l_n is:

$$l_n = 2\sqrt{(R/2)^2 - [(n-1)(r+d)]^2}$$

Then the average length of tube is:

$$L_{av} = \langle l_n \rangle = \frac{R + \sum_{n=2}^{(N-1)/2} 2\sqrt{(R/2)^2 - [(n-1)(r+d)]^2}}{N}$$

When the number of *N* is even, the length of tube l_n is:

$$l_n = 2\sqrt{(R/2)^2 - [(n-1/2)(r+d)]^2}$$

Then the average length of tube is:

$$L_{av} = \langle l_n \rangle = \frac{2\sum_{n=1}^{N/2} 2\sqrt{(R/2)^2 - [(n-1/2)(r+d)]^2}}{N}$$

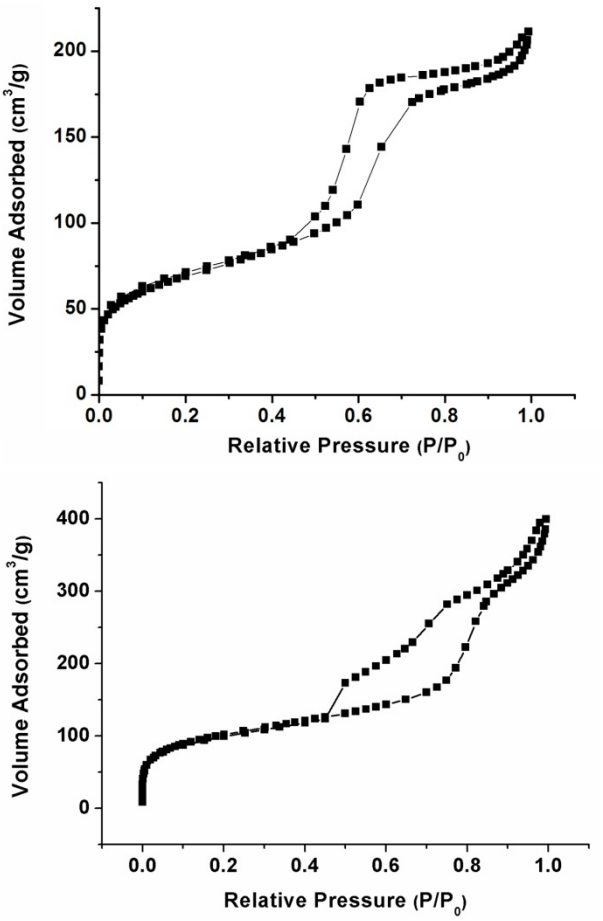

Figure S1. N_2 adsorption-desorption isotherms of the synthesized mesoporous (Top) and macro-mesoporous film (Bottom).

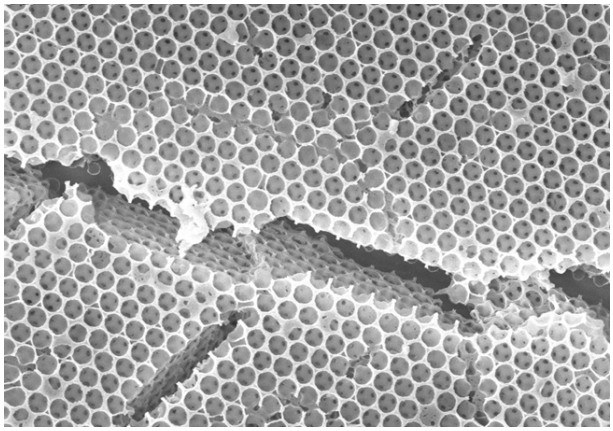

Figure S2. SEM image of the molecularly imprinted macro-mesoporous film after the extraction of all used templates.

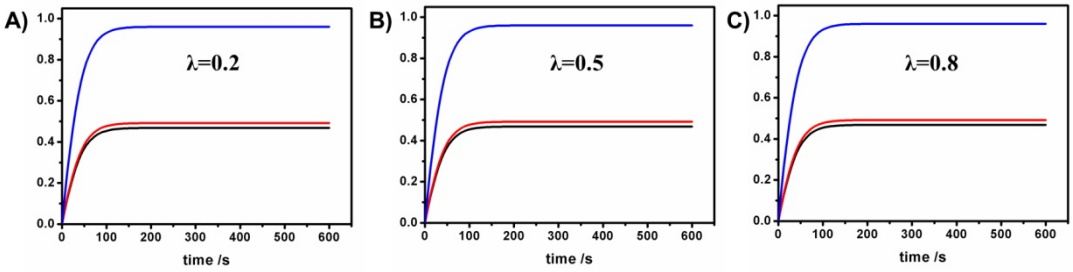

Figure S3. Dependence of the sensing behaviors on the variation of λ. $D_{pore}/L^2 = 13$, $2\Gamma_{site}/(C_0^b r_{pore}) = 1000$, $k_{ads}C_0^b = 0.02$, $K_{des} = 0.085$, $k_{ads}^{'} = 1.05k_{ads}$, $K_{des}^{'} = 0.95K_{des}$, where $\lambda = 0.2$ for (A), $\lambda = 0.5$ for (B), and $\lambda = 0.8$ for (C).