Electronic Supplementary Information

A new application of mesoporous carbon microparticles to nucleic acid detection

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Experimental

All chemically synthesized oligonucleotides were purchased from TaKaRa Biotechnology (Dalian). DNA concentration was estimated by measuring the absorbance at 260 nm. P123 ($EO_{20}PO_{70}EO_{20}$, M=5800) and FC-4 ($C_3F_7O(CFCF_3CF_2O)_2CFCF_3CONH(CH_2)_3N^+(C_2H_5)_2CH_3I^-$) were purchased from BASF Co Ltd. (BYC) and all the other chemicals were purchased from Aladin Ltd. (Shanghai, China). All the chemicals were used as received without further purification. The water used throughout all experiments was purified through a Millipore system.

Oligonucleotide sequences are listed below (mismatch underlined):

P_{HIV} (FAM dye-labeled ssDNA):

5’-FAM-AGT CAG TGT GGA AAA TCT CTA GC-3’

T_1 (complementary target):

5’-GCT AGA GAT TTT CCA CAC TGA CT-3’

T_2 (single-base mismatched target):

5’-GCT AGA GAT TGT CCA CAC TGA CT-3’

T_3 (two-base mismatched target):

5’-GCT AGA GAT TGT ACA CAC TGA CT-3’

T_4 (three-base mismatched target):

5’-GCT ATA GAT TGT ACA CAC TGA CT-3’

T_5 (non-complementary target to P_{HIV}):

5’-TTT TTT TTT TTT TTT TTT TTT TT-3’

MC microparticles were prepared by a nanocasting method using mesoporous silica (MS) NPs as a hard template.[1] MS particles were prepared according to established method using P123 and FC-4 as templates.[2] In a typical synthesis of MC, 1 g of MS was added into 5 g of water, followed by addition of 1.25 of sugar and 0.14 g of 98 % H_2SO_4. After stirring for a 5-h period at room temperature, the resulting mixture was dried at 100 ºC and 160 ºC for a 6-h period, respectively. After that, the mixture was added into 5 g of water, followed by addition of 0.75 g of sugar and 0.09 g of 98 % H_2SO_4. After stirring for 12 h, the mixture was dried at 160 ºC for a 6-h period. Finally, the carbonization process was carried out at 800 ºC under a nitrogen atmosphere for a 4-h period. The silica template was removed by washing the

carbon/silica composites by 1 M NaOH solution (an ethanol and water mixture) for a 12-h period. The MC microparticles were obtained after dryness at room temperature.

The nucleic acid detection experiments were performed at room temperature. In a typical process of quenching ssDNA by MC, 8-μL MC suspension was added into 292-μL Tris-HCl buffer solution. After that, 0.5-μL P_{HIV} was added into the above mixture, where the concentration of P_{HIV} in the solution is 50 nM. For fluorescence recovery of probe DNA by target, T_1 was added into the solution of P_{HIV}-MC complex , where the concentration of T_1 in the solution is 300 nM.

Powder X-ray diffraction (XRD) data were recorded on a Rigaku D/MAX 2550 diffractometer with Cu Kα radiation (λ = 1.5418 Å). Nitrogen isotherms were obtained at -196 ºC on a Micromeritics Tri-star. Samples were normally prepared for measurement by degassing at 150 ºC. Pore size distribution was calculated using Barrett-Joyner-Halenda (BJH) method. Scanning electron microscopy (SEM) measurements were made on a XL30 ESEM FEG scanning electron microscope at an accelerating voltage of 20 kV. Fluorescent emission spectra were recorded on a RF-5301PC spectrofluorometer (Shimadzu, Japan). Zeta potential measurements were performed on a Nano-ZS Zetasizer ZEN3600 (Malvern Instruments Ltd., U.K.).

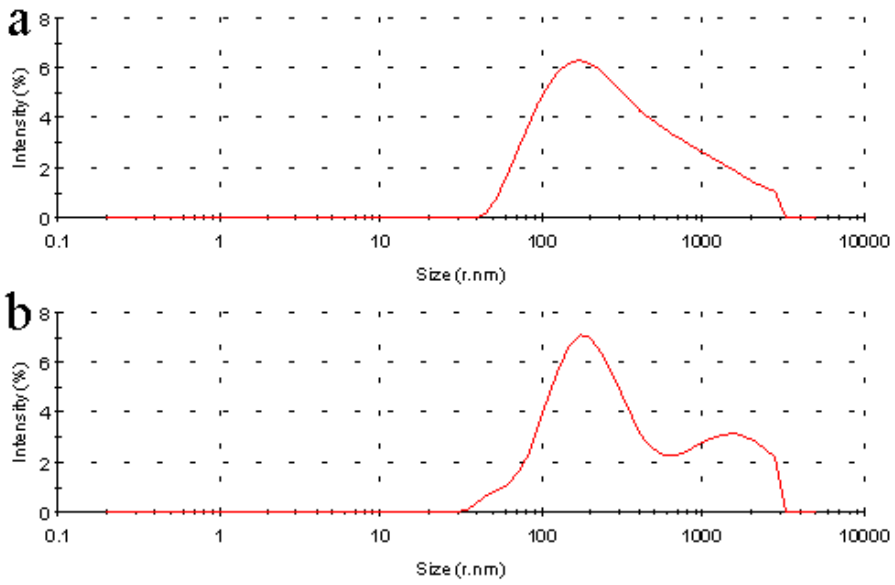

Fig. S1 DLS curves of MC particles suspended in water by sonication collected immediately and after a 0.5-h standing at room temperature.

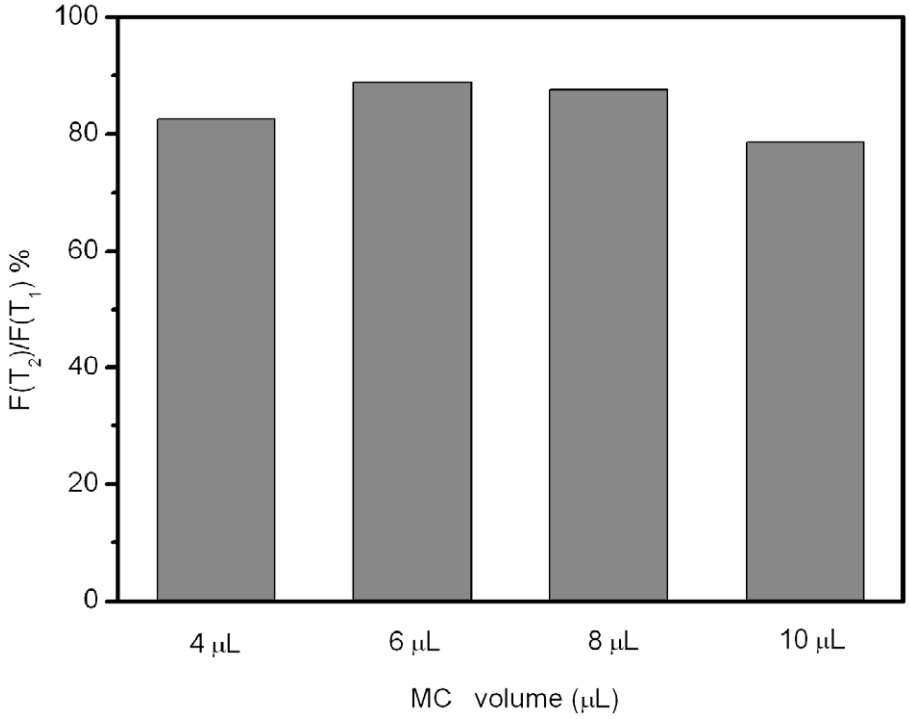

Fig. S2 Fluorescence intensity ratio of P_{HIV} + MC + T_2 to P_{HIV} + MC + T_1 in the presence of 4, 6, 8, and 10-μL MC sample. Excitation was at 480 nm, and the emission was monitored at 517 nm. All measurements were done in Tris-HCl buffer in the presence of 5 mM Mg^{2+} (pH: 7.4) at room temperature.

Platform	Quenching time (min)	Quenching efficiency (%)	Recovery time (min)	Recovery efficiency (%)	Ref.
MC	30	61.1	30	66.1	This work
SWCNT	65	48.5	65	82.5	3a
MWCNT	25	78.5	65	78.2	3a
Carbon nanoparticle	27	82.1	40	80.1	3b
graphene	2	96.0	30	77.5	4

Table S1 Comparison of the performance of various carbon materials toward nucleic acid detection.

References

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