Electronic Supplementary Information

Experimental section

Materials: Ammonium heptamolybdate ((NH$_4$)$_6$Mo$_7$O$_{24}$$\cdot$4H$_2$O), aniline, magnesium chloride (MgCl$_2$), sodium chloride (NaCl) and potassium chloride (KCl) were purchased from Beijing Chemical Corp. Commercial Mo$_2$C and Nafion® perfluorinated ion-exchange resin solution (5% w/w) were purchased from Sigma-Aldrich. All chemically synthesized oligonucleotides were purchased from Shanghai Sangon Biotechnology Co. Ltd. (Shanghai, China). The water used throughout all experiments was purified through a Millipore system.

Preparation of nanoporous molybdenum carbide nanowires (Mo$_2$C NWs): In a typical synthesis, the Mo$_2$C NWs were prepared according to previously reported method with modifications. Typically, 2.48 g of ammonium heptamolybdate and 1.60 g of aniline were added to 40 mL of distilled water and aqueous HCl (1 M) was added drop-wise, with magnetic stirring at room temperature, until a white precipitate was obtained at pH 4. After stirring at 50 ºC for 6 h, the product was filtered, washed with ethanol and dried at 60 ºC for a further 10 h. After expelling air for 2 h at room temperature using argon, the obtained products were calcined at 800 ºC for 5 h in argon flow and finally stored in a vacuum desiccator.

Characterizations: Powder X-ray diffraction (XRD) datum was recorded on a RigakuD/MAX 2550 diffractometer. Scanning electron microscopy (SEM)
measurements were made on a XL30 ESEM FEG scanning electron microscope at an accelerating voltage of 20 kV. Transmission electron microscopy (TEM) measurements were made on a HITACHI H-8100 electron microscopy (Hitachi, Tokyo, Japan) with an accelerating voltage of 200 kV. The Brunauer-Emmett-Teller (BET) surface area and pore volume were measured on a Quantachrome NOVA 1000 system at liquid N\textsubscript{2} temperature. Fluorescent emission spectra were recorded on a PerkinElmer LS55 Luminescence Spectrometer (PerkinElmer Instruments, U.K.).

**Fluorescence sensing assays:** The fluorescent DNA sensing was performed at room temperature in 10 mM Tris-HCl buffer (pH 7.4, containing 100 nM NaCl, 5 mM KCl and 5 mM MgCl\textsubscript{2}). The photoluminescence emission spectra were recorded after reaction for 10 min at room temperature. The fluorescent probe P\textsubscript{HIV} (50 nM) was hybridized with different amounts of target for 10 min in 300-μL buffer solution. Then Mo\textsubscript{2}C NWs suspension (5 μl, 5 mg/ml) was added. The final target concentration ranged from 50 pM to 300 nM. For kinetic study of fluorescence quenching, fluorescence spectra were recorded immediately after addition of Mo\textsubscript{2}C NWs. Excitation was at 480 nm, emission was monitored at 518 nm.

Oligonucleotide sequences used are listed below (mismatch underlined):

P\textsubscript{HIV} (FAM dye-labeled ssDNA):

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

T\textsubscript{1} (complementary target):

5’-GCT AGA GAT TTT CCA CAC TGA CT-3’

T\textsubscript{2} (single-base mismatched target):
5'-GCT AGA GAT TGT CCA CAC TGA CT-3'
Fig. S1 SEM images of the commercial Mo$_2$C particles.
Fig. S2 (a) N$_2$ adsorption-desorption isotherm and (b) pore size distribution of Mo$_2$C NWs.
**Fig. S3** Fluorescence spectra of $P_{\text{HIV}}$ (50 nM) at different conditions: $P_{\text{HIV}}$, $P_{\text{HIV}} + \text{bulk Mo}_2\text{C}$ and \text{bulk Mo}_2\text{C}.

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**Figure Description:**

A graph illustrating fluorescence spectra of $P_{\text{HIV}}$ (50 nM) under different conditions: $P_{\text{HIV}}$, $P_{\text{HIV}} + \text{bulk Mo}_2\text{C}$, and \text{bulk Mo}_2\text{C}. The x-axis represents wavelength in nm (520 to 640), and the y-axis represents fluorescence intensity in arbitrary units (a.u.). Three curves are depicted: a black line for $P_{\text{HIV}}$, a red line for $P_{\text{HIV}} + \text{bulk Mo}_2\text{C}$, and a green line for \text{bulk Mo}_2\text{C}. The peak intensity for $P_{\text{HIV}}$ is significantly higher than that for the other two conditions, indicating a higher fluorescence emission. The \text{bulk Mo}_2\text{C} condition shows the lowest fluorescence intensity, suggesting minimal interaction or quenching of fluorescence at this condition.
Reference