

Electronic Supplementary Information

for

Bifunctional monomer oligomers-based composite molecularly imprinted membranes for selective and sensitive electrochemical monitoring of Sudan I dye

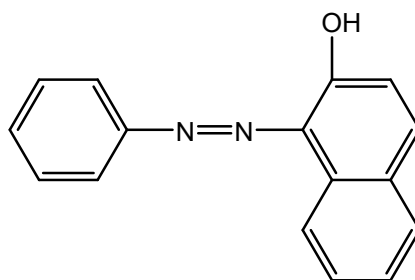
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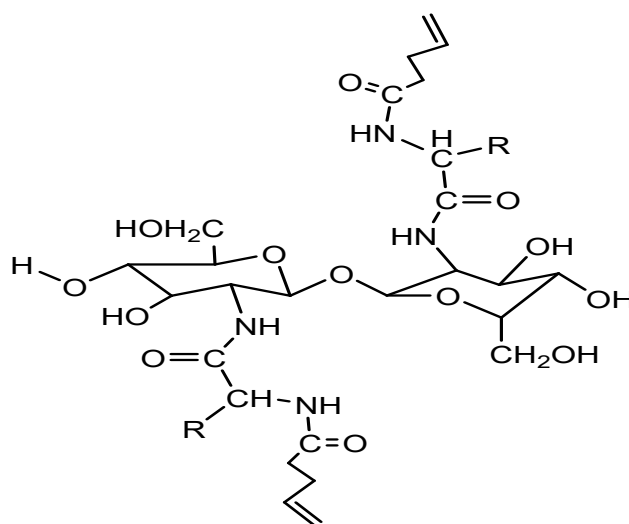
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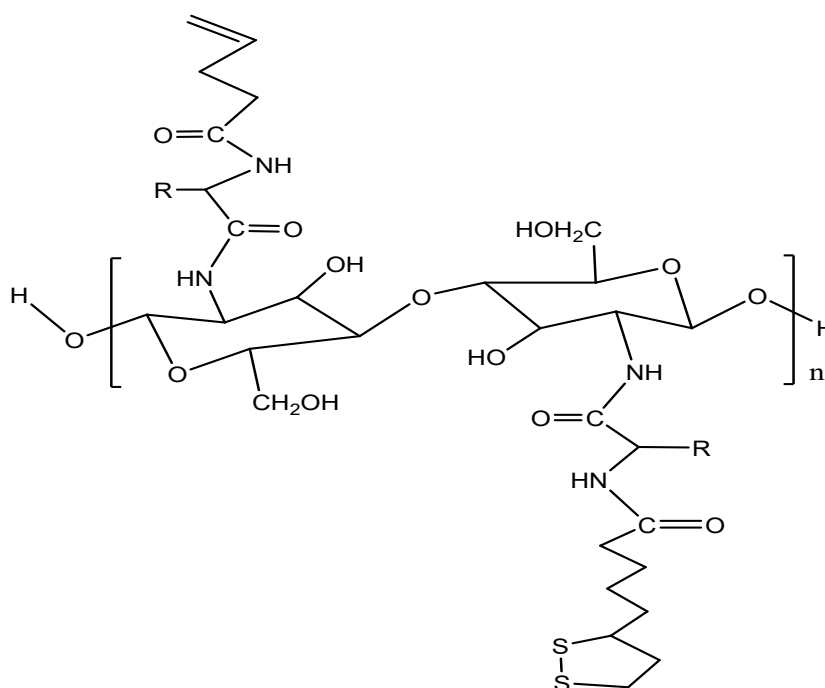
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Scheme S1. Chemical structure of Sudan I.



Scheme S2. Chemical structure of functional monomer oligomer (PAACO).



Scheme S3. Chemical structure of functional monomer oligomer (P(L)AACO).

Table S1. The chosen monomers and their computed energies in the absence and presence of SUDI in gas phase.

| Molecules | E (Hartree) | ΔE (Hartree) | ΔE (kJ/mol) ^a |
|--|---------------|----------------------|----------------------------------|
| SudanI | -796.5948441 | – | – |
| pentenyl-asparaginy-glucosamine (PEASNGA) | -1344.827885 | – | – |
| pentenyl-glutaminy-glucosamine (PEGLNGA) | -1383.865264 | – | – |
| pentenyl-seriny-glucosamine (PESERGA) | -1251.904866 | – | – |
| pentenyl-threony-glucosamine (PETHRGA) | -1290.93793 | – | – |
| pentenyl-tyrosiny-glucosamine (PETYRGA) | -1481.431211 | – | – |
| pentenyl-alany-glucosamine (PEALAGA) | -1177.027281 | – | – |
| pentenyl-glyciny-glucosamine (PEGLYGA) | -1137.998632 | – | – |
| pentenyl-isoleuciny-glucosamine (PEILEGA) | -1294.125873 | – | – |
| pentenyl-leuciny-glucosamine (PELEUGA) | -1294.135435 | – | – |
| pentenyl-phenylalaniny-glucosamine (PEPHEGA) | -1406.60403 | – | – |
| 4-pentenyl-valine-glucosamine (PEVALGA) | -1255.113943 | – | – |
| LA-any-glucosamine (LALAGA) | -2089.204693 | – | – |
| LA-glyciny-glucosamine (LAGLYGA) | -2050.167741 | – | – |
| LA-isoleuciny-glucosamine (LAILEGA) | -2206.273589 | – | – |
| LA-leuciny-glucosamine (LALEUGA) | -2206.283114 | – | – |
| LA-PhenylLAniny-glucosamine (LAPHEGA) | -2318.751552 | – | – |
| LA-valine-glucosamine (LAVALGA) | -2167.261661 | – | – |
| Sudan- PEASNGA | -2141.456443 | -0.03371442 | -88.51720971 |
| Sudan- PEGLNGA | -2180.461147 | -0.00103969 | -2.729706095 |
| Sudan- PESERGA | -2048.517669 | -0.01795899 | -47.15132824 |
| Sudan- PETHRGA | -2087.558191 | -0.02541751 | -66.73367251 |
| Sudan- PETYRGA | -2278.043591 | -0.0175356 | -46.0397178 |
| Sudan- PEALAGA | -1973.639422 | -0.01729697 | -45.41319473 |
| Sudan- PEGLYGA | -1934.604249 | -0.01077245 | -28.28306748 |
| Sudan- PEILEGA | -2090.740581 | -0.01986349 | -52.15159299 |
| Sudan- PELEUGA | -2090.740581 | -0.01030184 | -27.04748092 |
| Sudan- PEPHEGA | -2203.188863 | 0.01001112 | 26.28419556 |
| Sudan- PEVALGA | -2051.702794 | 0.00599272 | 15.73388636 |
| Sudan- LAALAGA | -2885.791272 | 0.00826513 | 21.70009881 |
| Sudan- LAGLYGA | -2846.761667 | 0.0009189 | 2.412571949 |
| Sudan- LAILEGA | -3002.887783 | -0.01935074 | -50.80536787 |
| Sudan- LALEUGA | -3002.8885 | -0.01054131 | -27.6762094 |
| Sudan- LAPHEGA | -3115.337421 | 0.00897513 | 23.56420382 |
| Sudan- LAVALGA | -2963.855033 | 0.00147189 | 3.864447195 |

a: 1 Hartree = 2625.5 kJ/mol.

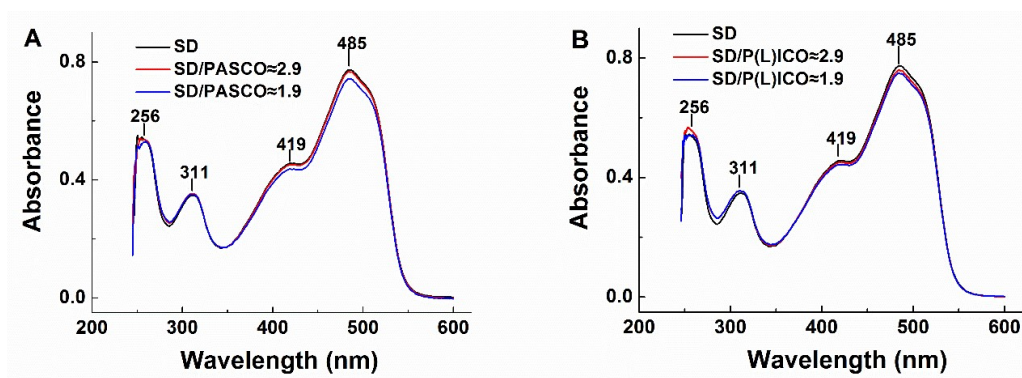


Fig. S1. UV-vis spectra of a complex formed by 0.02 mg mL^{-1} Sudan I and different ratios FMOs in DMF/H₂O ($v/v = 1.5 : 1$) solution. (A) PASCO, (B) P(L)ICO.

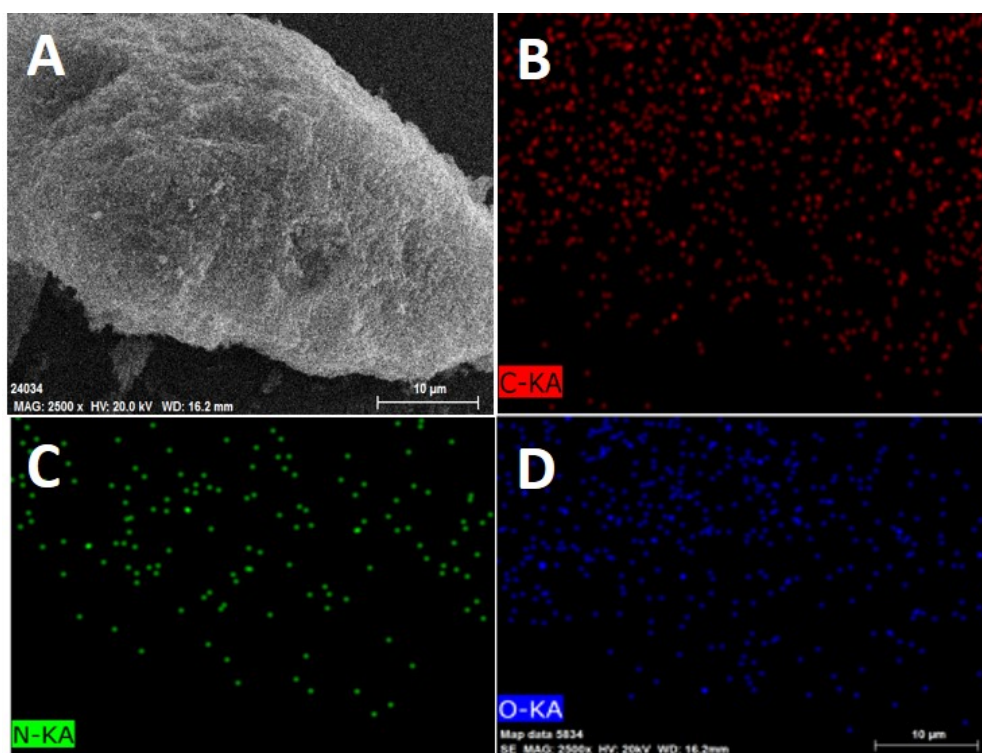


Fig. S2. (A) SEM image and the corresponding EDS elemental mappings of (B) C, (C) N and (D) O from PASCO.

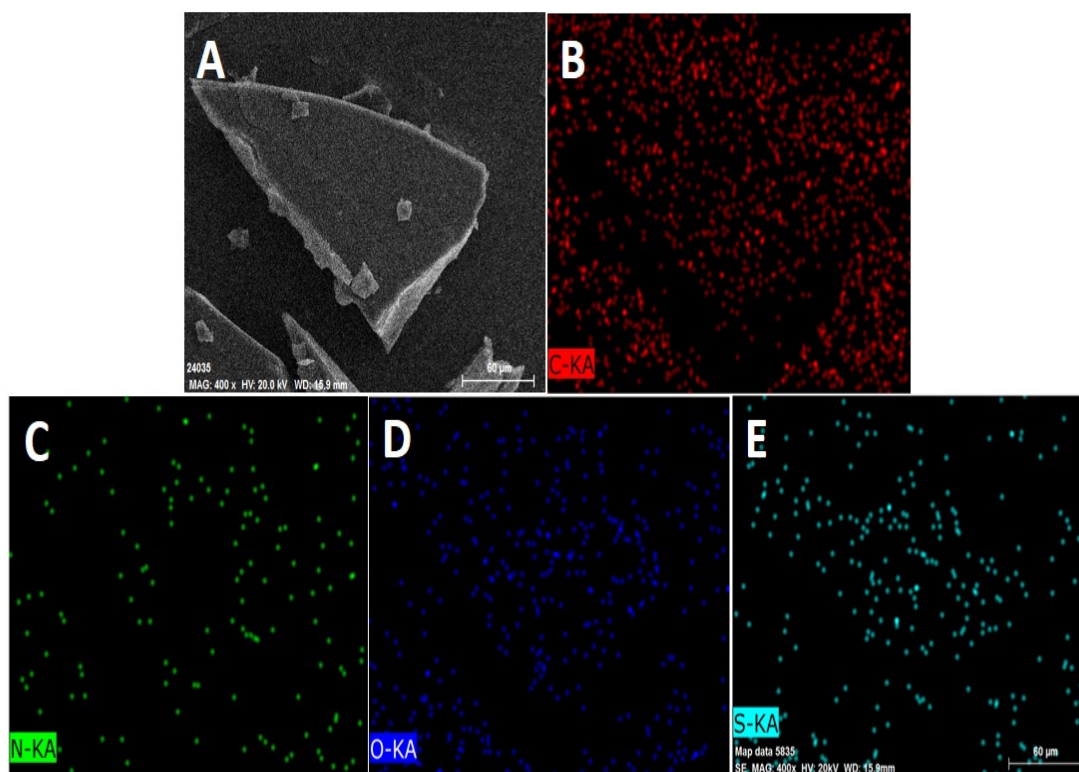


Fig. S3. (A) SEM image and the corresponding EDS elemental mappings of (B) C, (C) N, (D) O and (E) S from P(L)ICO.

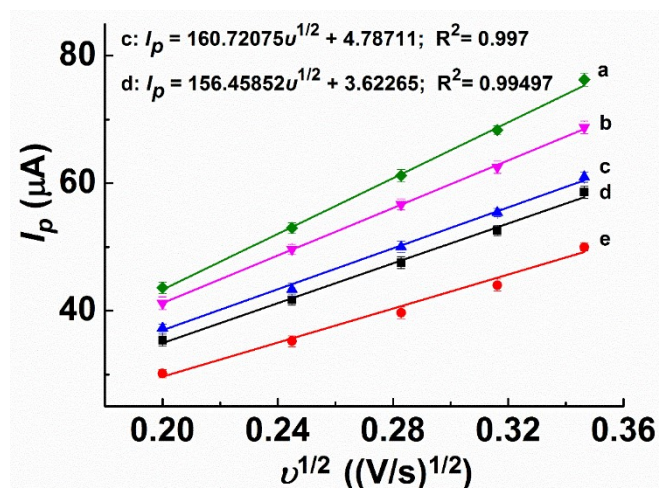


Fig. S4. Relationship between I_p of CV vs $v^{1/2}$ of different electrodes modified by AuNPs, which were prepared by different CV cycles (a: 9; b: 5; c: 4; d: 0; e: 3), in 0.25 M NaAc/HAc (pH 6.5) solution containing 5.0 mM $K_3[Fe(CN)_6]$. The error bars represent the standard deviation of results for $n=3$.

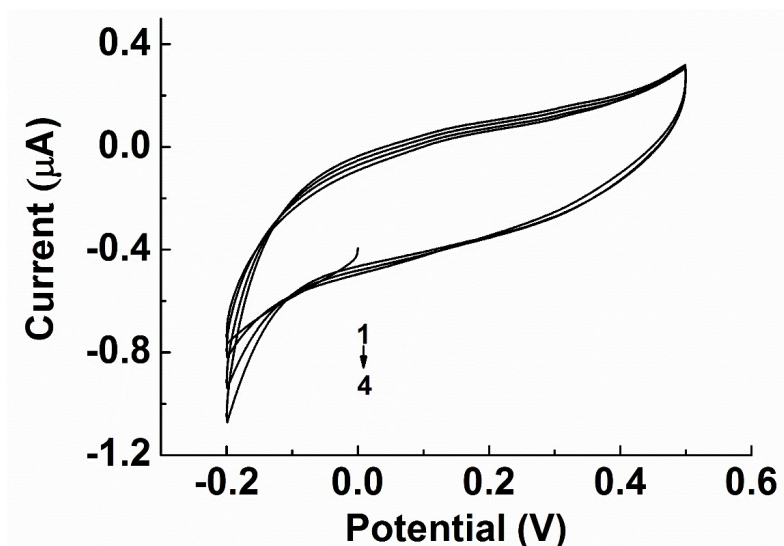


Fig. S5. CV behavior of GCE electrode during potential cycling in 0.1 mM HAuCl₄ solution containing 0.1 mM Na₂SO₄.

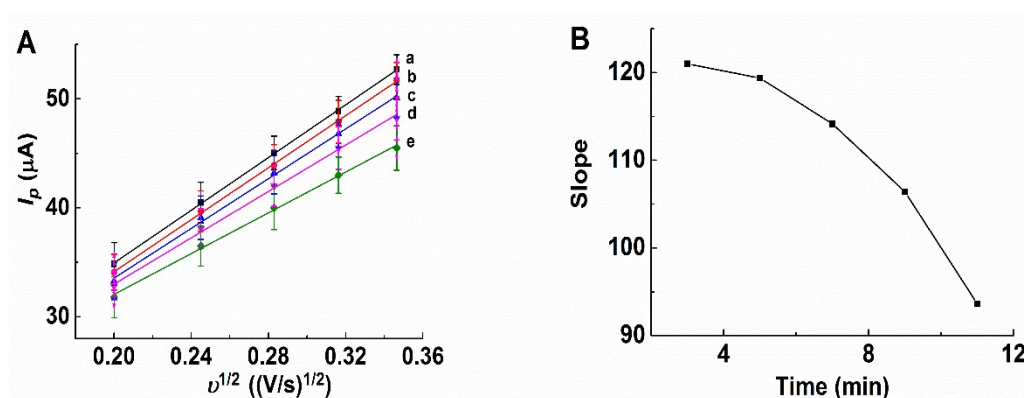


Fig. S6. A: The relationship between I_p vs $v^{1/2}$ of AuNPs/GCE self-assembled in 2.0mMP(L)ICO solution for different time (a: 3 min; b: 5 min; c: 7 min; d: 9 min; e: 11 min) by CV scanning in 0.25 M NaAc/HAc (pH 6.5) solution containing 5.0 mM K₃[Fe(CN)₆]. B: The relationship between the slope of I_p vs $v^{1/2}$ curve and the self-assembly time of AuNPs/GCE. The error bars represent the standard deviation of results for n=3.

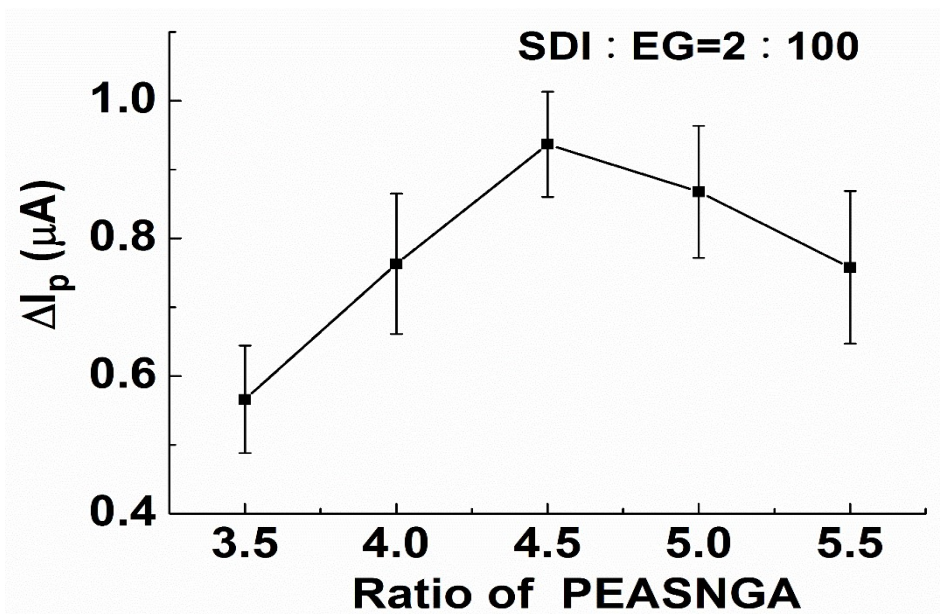


Fig. S7. The influence of the PEASNGA's ratio in primary polymerization solution was investigated by MIM/GCE sensors to 0.2 μM Sudan I in 0.25 M NaAc/HAc (pH 6.5) solution containing 1.0 mM ferrocenemethanol. The molar ratio of Sudan I to EGDMA was fixed at 2:100. The error bars represent the standard deviation of results (n=3).

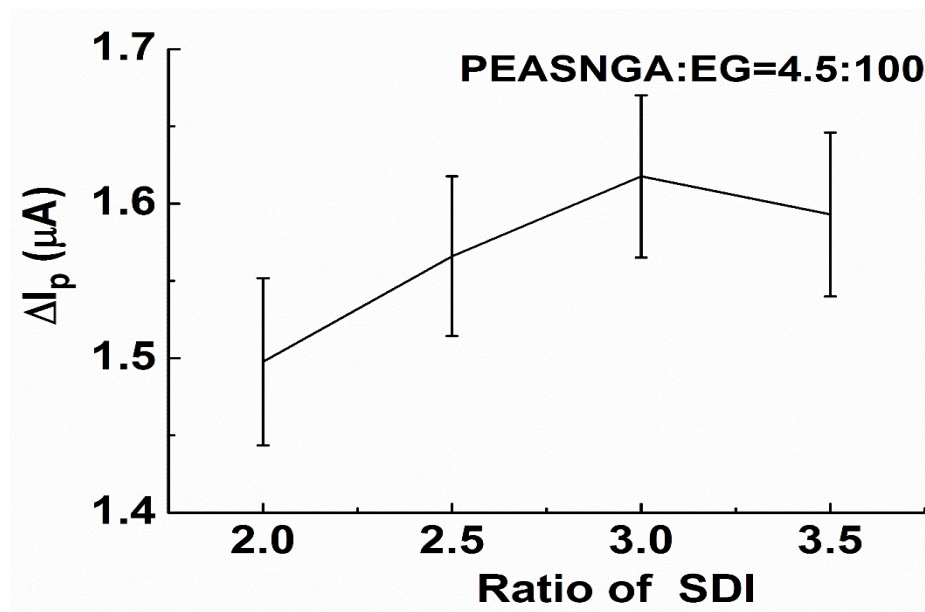


Fig. S8. Effect of the molar ratio of template, monomer and crosslinking agent added in the polymerization on the response of the MIM/Fn-AuNPs/GCE sensor to 0.2 μM Sudan I in 0.25 M NaAc/HAc (pH 6.5) solution containing 1.0 mM ferrocenemethanol. The molar ratio of PALAGA to EGDMA was fixed at 4.5:100.

The error bars represent the standard deviation of results (n=3).

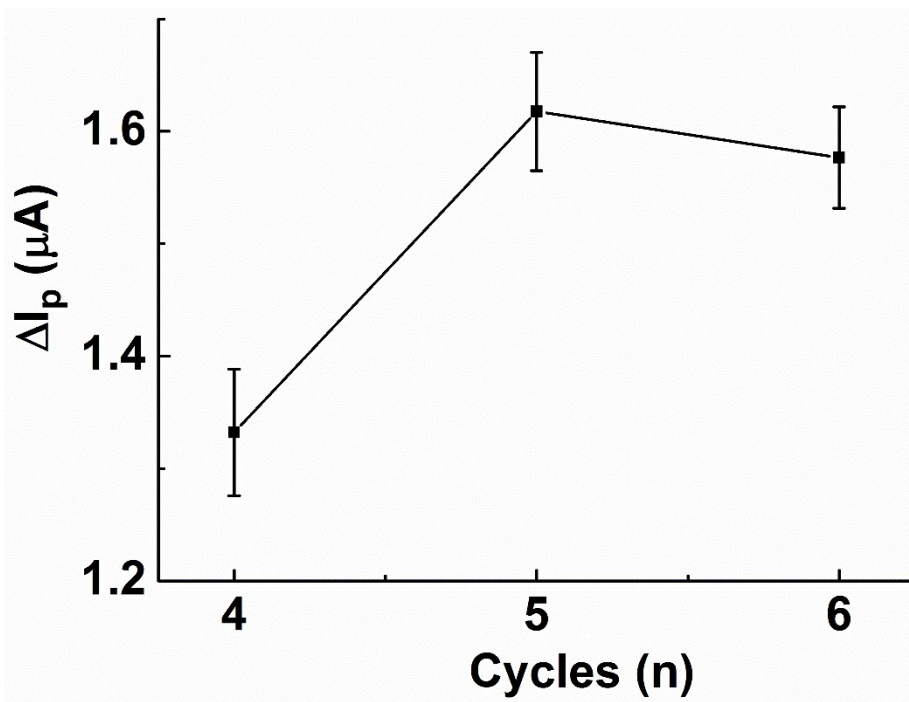


Fig. S9. Effect of CV cycle on sensor response in secondary composite polymerization toward 0.2 μM Sudan I in 0.25 M NaAc/HAc (pH 6.5) solution containing 1.0 mM ferrocenemethanol. The error bars represent the standard deviation of results (n=3).

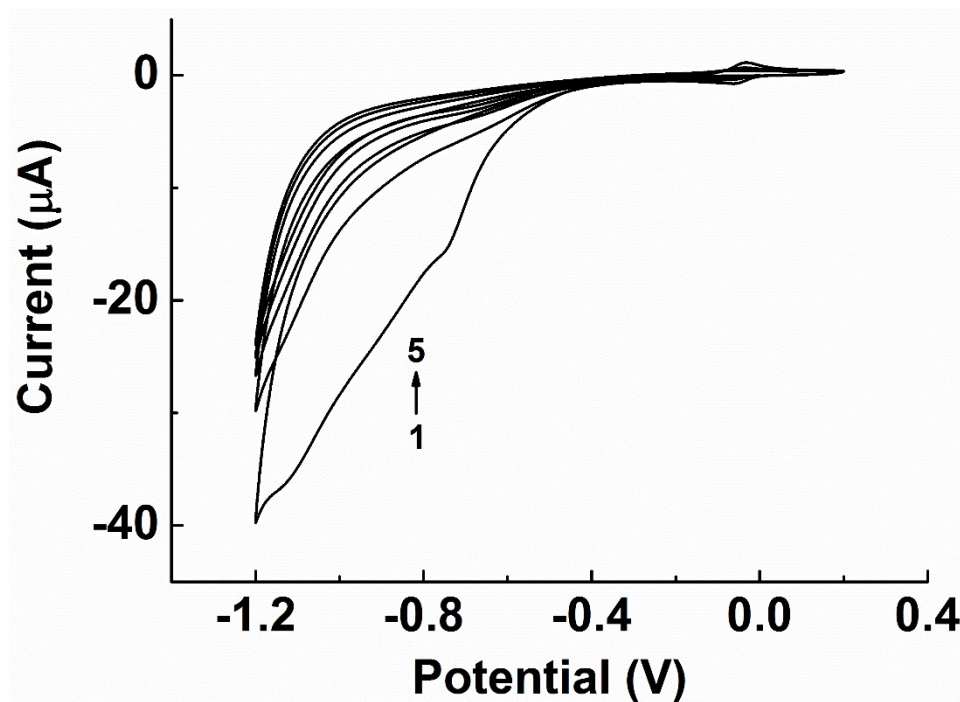


Fig. S10. Cyclic voltammograms for the electrochemical polymerization of MBA (12

mg mL⁻¹) initiated by APS (1 mg mL⁻¹) in 0.25 M NaAc solution (pH =6.5). Scan rate 20 mV s⁻¹.

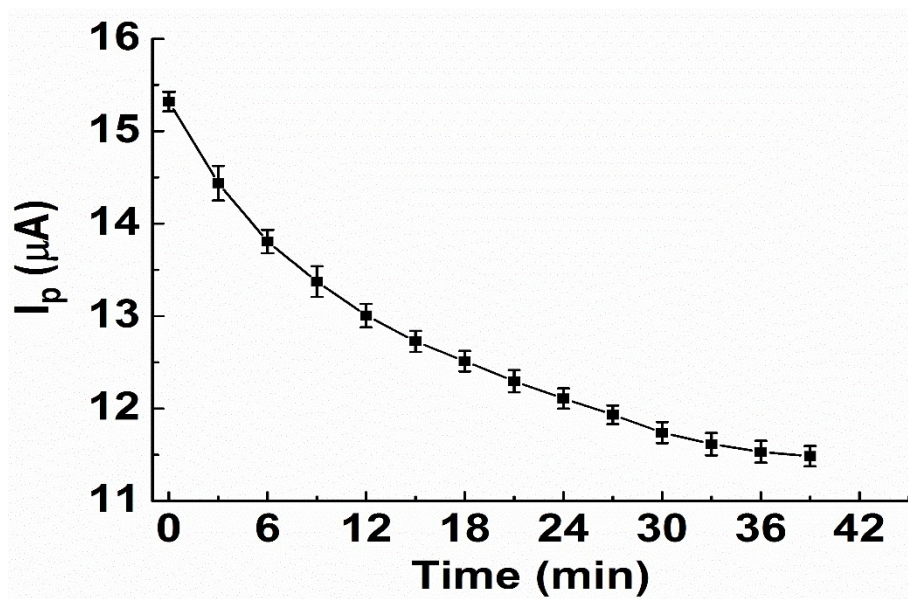


Fig. S11. Effect of incubation time on the current response of MIM(PM)/Fn-AuNPs/GCE recorded in 0.25 M NaAc/HAc (pH 6.5) solution containing 1.0 mM ferrocenemethanol and 2 μ M Sudan I. The error bars represent the standard deviation of results (n=3).

Table S2. Comparison of different sensors for monitoring Sudan I.

| Modified electrode | Methods | Linear range (μ M) | LOD (nM) | References |
|--------------------------------------|---------|-------------------------|----------|--------------|
| AuNPs/RGO/GCE | LSV | 0.01–70 | 1.0 | 1 |
| ZnO/NPs/IL/CPE | SWV | 0.01–400 | 8.0 | 2 |
| Graphene/ β -CD/PtNPs/GCE | DPV | 0.005–66.68 | 1.6 | 3 |
| Bi ₂ WO ₆ /GCE | DPV | 0.02–114.6 | 5.0 | 4 |
| MWCNTs/AuNPs/GCE | AM | 10–260 | 4.0 | 5 |
| MIM(PM)/Fn-AuNPs/GCE | DPV | 0.02–3.5 | 2.0 | Present work |

AuNPs: Gold nanoparticles; LOD: Limit of detection; RGO: Reduced graphene oxide; GCE: Glassy carbon electrode; LSV: Linear sweep voltammetry; IL: Ionic liquid; CPE: Carbon paste electrode; SWV: Square wave voltammetry; β -CD: β -cyclodextrin; PtNPs: Platinum nanoparticles; MWCNTs: Multiwalled carbon nanotubes; AM: Amperometric; MIM: Molecular imprinted membrane; PM: Polymethylenebisacrylamide; Fn: Functional.

References

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