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## Correction: Advanced 2D MoS<sub>2</sub>–chitosan nanocomposites for ultra-sensitive and selective dopamine detection

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Pietro Giuseppe Gucciardi,<sup>b</sup> Wissem Cheikhrouhou-Koubaa<sup>d</sup> and Giovanni Neri<sup>c</sup>Correction for 'Advanced 2D MoS<sub>2</sub>–chitosan nanocomposites for ultra-sensitive and selective dopamine detection' by Ratiba Wali et al., *Mater. Adv.*, 2025, **6**, 6038–6051, <https://doi.org/10.1039/D5MA00133A>.

The authors regret that, due to an unfortunate technical error, the version of the manuscript provided for publication was not the final revised version, which included the additional experiments and clarifications requested by the reviewers. While the scientific content of the originally published article remains correct, the authors wish to ensure the completeness of the scientific record by publishing the version that led to the article being deemed acceptable.

A full list of the differences between the published article and the final reviewed version of the manuscript is provided below. In summary, these differences include:

- Two additional figures (Fig. 1 and Fig. 11), plus the addition of an inset to Fig. 16 (previously Fig. 14) and sub-panels to Fig. 18 (previously Fig. 16). The addition of the two new figures results in changes in the numbering of the original figures; in the corrected text below, the new figure numbering is given.

- The addition of new rows to Table 3.
- Numerous amendments to the phrasing of the main article text.
- Details of new experiments as described in Sections 3.5, 3.6, and 3.7 (stability, pH, and antipollution studies).
- Eight additional references, listed in their order of appearance in the revised version. This results in changes in the numbering of the original references; in the corrected text below, the new reference numbering is given.

Detailed list of changes:

### Page 6038 – Section 1:

Original text:

“For these reasons, different methods have been used for DA analysis, including flow injection, chromatography, electrolysis, and chemiluminescence.<sup>8,9</sup>”

Correction:

“For these reasons, different methods have been used for DA analysis determination, including flow injection analysis, chromatography, high-performance liquid chromatography, electrolysis, spectrophotometry, capillary electrophoresis, and chemiluminescence.<sup>8,9</sup>”

The new ref. 9 is included in the reference list herein as ref. 1.

### Page 6039 – Section 2.1:

Original text:

“MoS<sub>2</sub> powder and sodium cholate were used to synthesize 2D-MoS<sub>2</sub> via liquid phase exfoliation.<sup>21</sup> In this process, MoS<sub>2</sub> powder (5 mg mL<sup>-1</sup>) was dispersed in a SC watery solution (1.5 mg mL<sup>-1</sup>).”

Correction:

“MoS<sub>2</sub> powder and sodium cholate (SC) were used to synthesize 2D-MoS<sub>2</sub> via Liquid Phase Exfoliation.<sup>22</sup> In this process, MoS<sub>2</sub> powder (5 mg ml<sup>-1</sup>) was dispersed in a SC aqueous solution (1.5 mg ml<sup>-1</sup>).”

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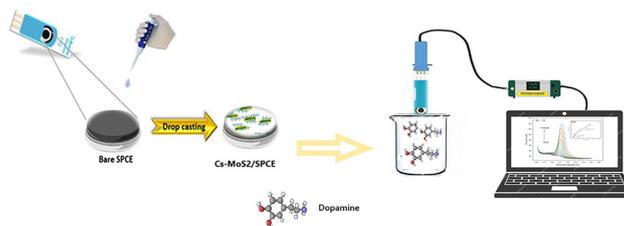


Fig. 1 Schematic diagram of sensor preparation.

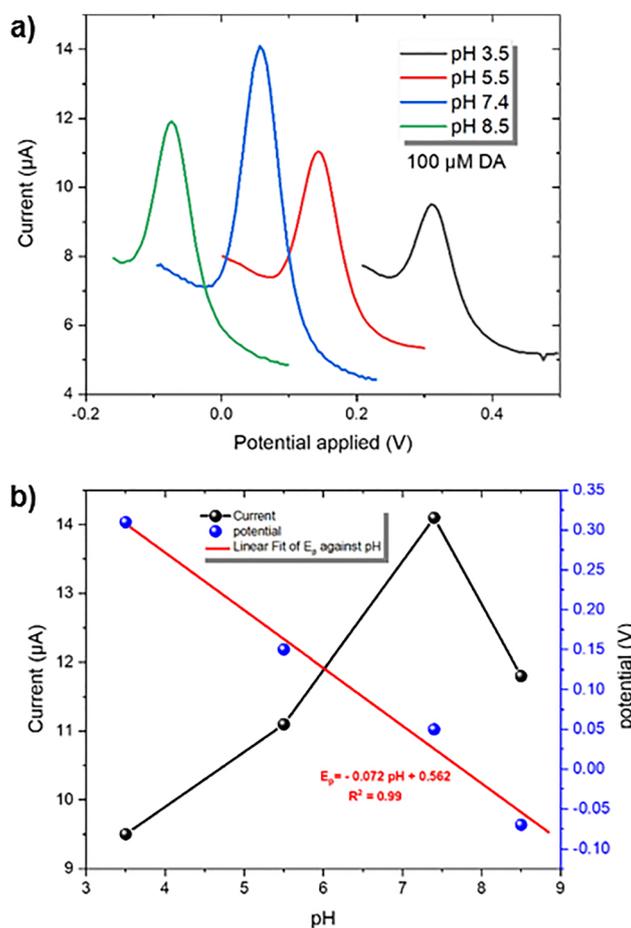


Fig. 11 (a) DPV of 25 μM DA on Cs-MoS<sub>2</sub>-SPCE at various pH values: 3.0, 7.4 and 8.5. (b) The dependence of oxidation peak potential on pH values (blue) and the dependence of oxidation peak current on pH values (black)

#### Page 6040 – Section 2.4:

Original text:

“... onto the working electrode surface. Subsequently, ...”

Correction:

“... onto the working electrode surface (Fig. 1). Subsequently, ...”

Original text:

“Electrochemical impedance spectroscopy was conducted utilizing a potentiostat Galvanostat. All experiments were carried out at room temperature.”

Correction:

“Electrochemical impedance spectroscopy was conducted utilizing a potentiostat Galvanostat (Autolab Methrom, PGSTAT 204) controlled by Nova 2.1 software for data acquisition. All experiments were carried out at room temperature.”



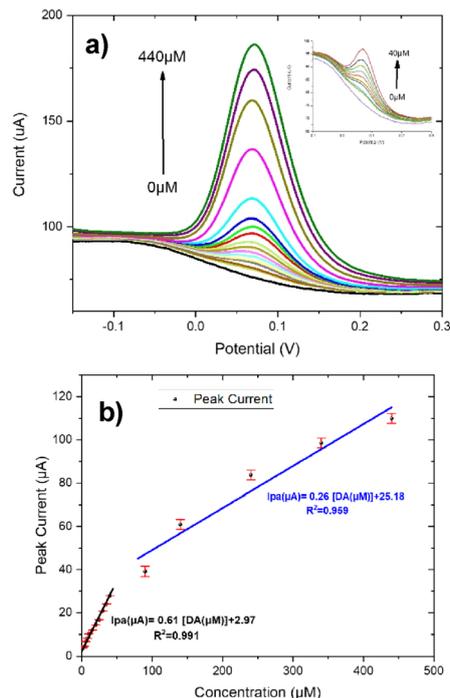


Fig. 16 (a) DPVs on Cs-MoS<sub>2</sub>-SPCE at various concentrations of DA (0–440 μM) in 0.01 PBS at 7.4 pH; inset, DPV response at DA concentration from 0 to 40 μM. (b) Calibration curves of Cs-MoS<sub>2</sub>-SPCE towards dopamine concentration.

#### Page 6040 – Section 3.1:

Original text:

“MoS<sub>2</sub> nanosheets (Fig. 1a) exhibit four transitional peaks denoted as A and B excitonic peaks at 673 nm and 613 nm, respectively, and a C-excitonic band at 400–460 nm, superposed on a continuum scattering background.”

Correction:

“MoS<sub>2</sub> nanosheets (Fig. 2a) show four different optical transitions which include the A and B excitonic peaks at 673 nm, 613 nm, respectively, along with a wide C-excitonic band between 400 and 460 nm, layered over a continuum scattering background.”

#### Page 6043 – Section 3.2:

Original text:

“...( $n = 1$  in our case),  $A$  is the effective area of the SPCE...”

Correction:

“...( $n = 1$  in our case), since the Fe(CN)<sub>6</sub><sup>3-</sup>/Fe(CN)<sub>6</sub><sup>4-</sup> couple undergoes a single electron transfer),  $A$  is the effective area of the SPCE...”

Original text:

“Fig. 6 Calculated electrochemical active surface areas of the different electrodes.”

Correction:

“Fig. 7 Calculated electrochemical active surface areas (ESAs) of the bare (black), MoS<sub>2</sub> (red), Cs(25%)–MoS<sub>2</sub> (green), Cs(50%)–MoS<sub>2</sub> (blue), Cs(75%)–MoS<sub>2</sub> (turquoise), and Cs (violet) electrodes.”

#### Page 6045 – Section 3.3:

Original text:

“...enhancing conductivity and sensitivity in DA detection.

The effect of Cs(50)–MoS<sub>2</sub> hybrid nanocomposite loading...”

Correction:

“...enhancing conductivity and sensitivity in DA detection.

The pH of the electrolyte strongly influenced dopamine detection at the Cs-MoS<sub>2</sub>-modified SPCE. Differential pulse voltammetry (DPV) was carried out in 0.01 M PBS containing 100 μM DA over a pH range of 3.5–8.5. As shown in Fig. 11a, the oxidation peak potential shifts to less positive values with increasing pH, indicating that protons participate in the DA redox reaction<sup>1,62</sup>. A linear correlation between peak potential and pH was found (Fig. 11b, red line), described by the equation:

$$E(V) = -0.072\text{pH} + 0.562 \quad (R^2 = 0.99) \quad (5)$$



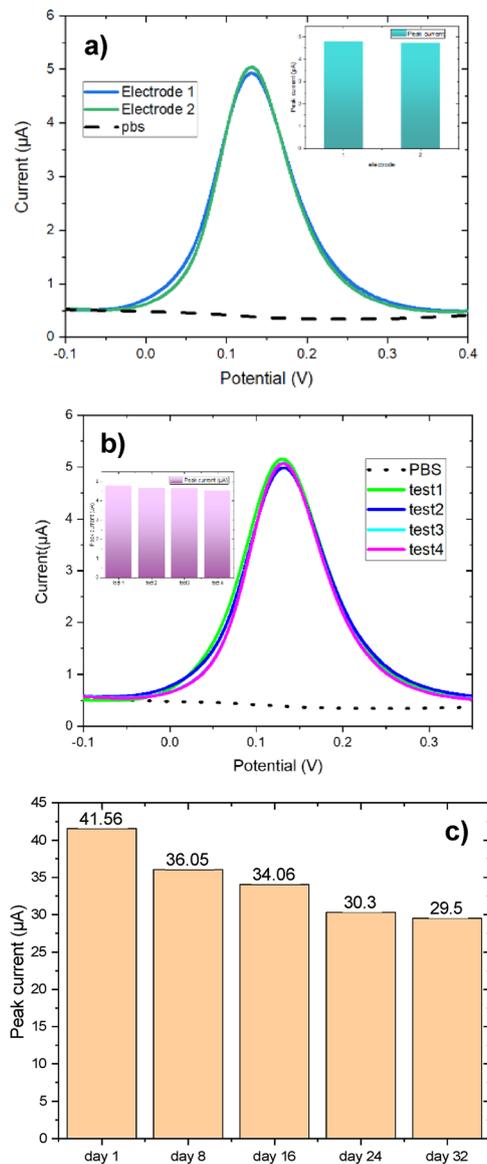


Fig. 18 (a) Reproducibility of Cs–MoS<sub>2</sub>–SPCE response; (b) repeatability in the sensor of two fabricated sensors, (c) stability for 32 days.

The observed slope of  $-0.072 \text{ V pH}^{-1}$  is close to the theoretical Nernst slope of  $-0.059 \text{ V pH}^{-1}$  at  $25^\circ\text{C}$ , confirming that the DA oxidation involves an equal number of electrons and protons.<sup>62–64</sup> Moreover, the oxidation peak current increased from pH 3.5 up to pH 7.4, then declined beyond this point (Fig. 11b, black line). Based on the observed maximum oxidation response at physiological pH, all subsequent dopamine measurements were conducted at pH 7.4, in agreement with previously reported findings.<sup>59,65</sup>

The effect of Cs(50)–MoS<sub>2</sub> hybrid nanocomposite loading. . .”

The new ref. 62–65 are included in the reference list herein as ref. 2–5.

Original text:

“Fig. 10 The effect of different amounts of the active electrode material (Cs(50)–MoS<sub>2</sub>) on sensitivity towards the detection of dopamine using the DPV test.”

Correction:

“Fig. 12 The effect of different amounts of active electrode material (Cs(50)–MoS<sub>2</sub>) on sensitivity towards the detection of dopamine using the DPV test with various DA concentrations (from 0 to 100 μM) in 0.01 M PBS at pH 7.4, 0.005 V step potential, 0.025 V modulation amplitude, 0.05 s modulation time.”



**Page 6046 – Section 3.3:**

Original text:

“Fig. 12 DPV response on 100 mM DA recorded on bare, MoS<sub>2</sub>, and Cs–MoS<sub>2</sub> modified SPCEs in 0.01 M PBS.”

Correction:

“Fig. 14 DPV response on 100 μM DA recorded on bare, MoS<sub>2</sub>, and Cs–MoS<sub>2</sub> modified SPCE in 0.01 M PBS at pH 7.4, 0.005 V step potential, 0.025 V modulation amplitude, 0.05 s modulation time.”

Original text:

“Fig. 13 (a) Calibration curves from the DPV technique of bare and modified SPCEs with different amounts of chitosan. (b) The effect of different amounts of chitosan on sensitivity.”

Correction:

“Fig. 15 (a) Calibration curves from DPV technique of bare and modified SPCE with different amounts of chitosan. (b) The effect of different amounts of chitosan on sensitivity using the DPV test with various DA concentration (0 to 100 μM) in 0.01M PBS at pH 7.4, 0.005 V step potential, 0.025 V modulation amplitude, 0.05 s modulation time.”

**Page 6047 – Section 3.4:**

Original text:

“The limit of detection (LOD) of this sensor is 0.8 mM. Overall, the electrode devised in this study exhibits suitability for use as a dopamine sensor.”

Correction:

“The limit of detection (LOD) of this sensor was 0.8 μM. The presence of two linear ranges in the calibration curve reflects a change in the controlling mechanism.<sup>68</sup> At low dopamine levels, adsorption onto high-affinity sites in the Cs–MoS<sub>2</sub> composite (*e.g.*, edges, defects, Cs-rich regions) dominates, yielding a steep, high-sensitivity slope.<sup>68</sup> As these sites saturate at higher concentrations, the response becomes limited by dopamine diffusion from the bulk and/or slower electron transfer at the crowded interface, producing a second, gentler slope.<sup>68</sup> This switch from adsorption- to diffusion-controlled kinetics is commonly observed in nanocomposite- modified electrodes.<sup>68</sup>”

The new ref. 68 is included in the reference list herein as ref. 6.

Original text:

“Fig. 14 (a) DPV curves on Cs–MoS<sub>2</sub>–SPCE at various concentrations of DA (0–440 mM) in 0.01 PBS. (b) Calibration curves of Cs–MoS<sub>2</sub>–SPCE towards dopamine concentration.”

Correction:

The revised Fig. 16 is shown herein.

**Page 6047 – Section 3.5:**

Original text:

“A crucial aspect determining the applicability of a biosensor is its capacity to selectively differentiate analytes from interferents. In this study, the electrochemical responses of 100 mM DA on Cs–MoS<sub>2</sub> in the presence of various interferents was studied. The impact of various bioorganic species, including L-tyrosine, uric acid, urea, ascorbic acid, and glucose, as well as common inorganic ions such as Na<sup>+</sup> and K<sup>+</sup>, on the electrochemical response of dopamine was investigated. The results are shown in Fig. 15, revealing that there were no significant changes in the current response of dopamine in the presence of L-tyrosine, uric acid, glucose, urea, ascorbic acid, sodium ions, and potassium ions. These findings indicate that the sensor exhibits excellent selectivity for the determination of dopamine (DA) even in the presence of various interfering bioorganic and/or inorganic ions.”

Correction:

“A critical determinant of biosensor applicability is its ability to selectively distinguish the target analyte from potential interferents. To evaluate this, the selectivity of the Cs–MoS<sub>2</sub>–SPCE sensor was systematically assessed using 100 μM dopamine (DA) in 0.01 M PBS (pH 7.4) alongside common bioorganic interferents—L-tyrosine, uric acid, urea, ascorbic acid, and glucose—as well as inorganic ions (Na<sup>+</sup> and K<sup>+</sup>). As illustrated in Fig. 17a, the DPV response for DA exhibited a well-resolved oxidation peak at ~0.15 V, with no observable overlap or peak shifting in the presence of interferents, confirming minimal cross-reactivity. Chronoamperometric studies (Fig. 17b) further validated the sensor’s robustness, demonstrating stable current responses (<5% signal fluctuation) during sequential additions of DA (25–125 μM) over 125 s, even in the presence of competing species. Notably, none of the tested interferents induced significant alterations (<5% deviation) in the DA current response, underscoring the sensor’s exceptional selectivity. These results collectively affirm the Cs–MoS<sub>2</sub>–SPCE’s reliability for accurate DA quantification in complex biological environments containing structurally similar biomolecules and physiologically abundant ions.”

**Page 6047 – Section 3.6:**

Original text:

“3.6 Reproducibility and repeatability”

Correction:

“3.6 Reproducibility, repeatability, and stability”



Original text:

“...of the prepared electrode.”

Correction:

“...of the prepared electrode.”

To assess the long-term storage stability of the Cs-MoS<sub>2</sub> electrode, it was maintained under ambient conditions for 32 days. Every seven days ( $n = 5$ ), its current response to 100  $\mu\text{M}$  DA was measured under the same experimental parameters (pH 7, 0.1 M PBS).<sup>73</sup> The electrode showed consistent performance, reflected in a relative standard deviation (RSD%) of 4.33% (Fig. 17c). Moreover, even after 30 days of periodic use and storage, the modified electrode retained approximately 71% of its initial current response, indicating satisfactory storage stability.”

The new ref. 73 is included in the reference list herein as ref. 7.

**Page 6047 and 6048– Section 3.7:**

Original text:

“...a known concentration of dopamine was introduced...”

Correction:

“...a known concentration of dopamine (4  $\mu\text{M}$ , 100  $\mu\text{M}$ , and 300  $\mu\text{M}$ ) was introduced...”

Original text:

“...The recovered concentration of DA in the spiked samples was 97.49% for blood serum and 105.76% for saliva of the one added, indicating that the detection of dopamine using this procedure is almost free from interferences present in the biological sample matrices.

The resulting findings and recoveries are tabulated in Table 3. Ultimately, the Cs-MoS<sub>2</sub>-SPCE demonstrated promising efficacy for real-time applications. These results suggested that electrochemical sensors based on Cs-MoS<sub>2</sub>-SPCEs, as illustrated, could be applied to the determination of dopamine in real samples.”

Correction:

“As summarized in Table 3, the sensor demonstrated excellent accuracy and precision across different spike levels. In blood serum, recoveries ranged from 93.5% to 101.6%, with relative standard deviations (RSDs,  $n = 3$ ) below 0.93%. For saliva, recoveries were between 97.72% and 105.76%, with even lower RSDs ( $\leq 0.44\%$ ), indicating that the detection of dopamine by this procedure is almost free from interferences present in the biological sample matrices.

Recovery studies in spiked human serum and saliva (Table 3), demonstrating high accuracy (93.5–105.8%) across a clinically relevant dopamine (DA) concentration range (0.1–440  $\mu\text{M}$ ). While the sensor's limit of detection (LOD, 0.8  $\mu\text{M}$ ) exceeds basal DA levels in healthy individuals (1–10 nM in serum per saliva),<sup>76</sup> it is well-suited for detecting elevated DA concentrations encountered in clinical and pharmacological contexts. For instance, in Parkinson's disease patients undergoing L-DOPA therapy, DA levels in peripheral fluids can rise to 0.1–10  $\mu\text{M}$  due to metabolite spillover, aligning with the sensor's operational range. Similarly, the sensor reliably quantifies DA surges induced by dopaminergic drugs (*e.g.*, antipsychotics or stimulants) or pathological conditions such as pheochromocytoma, where serum DA can reach micromolar levels during catecholamine overproduction. The robust recovery rates (*e.g.*, 101.6% for 300  $\mu\text{M}$  in serum, 100.1% for 300  $\mu\text{M}$  in saliva) confirm its precision in complex biological matrices, even after 100-fold dilution to mitigate matrix interference. These results underscore the sensor's utility for real-world applications targeting elevated DA monitoring, such as therapeutic drug tracking or disease management, rather than basal physiological levels, which require ultrasensitive methods. Future refinements to enhance sensitivity could expand its applicability to basal DA detection in undiluted samples.”

The new ref. 76 is included in the reference list herein as ref. 8.

**Page 6048 – Section 3.6:**

Original text:

“Fig. 16 (a) Reproducibility test using two different electrodes tested at the same conditions, (b) repeatability test of the same sensor at a fixed concentration.”

Correction:

The revised Fig. 18 is shown herein.

**Page 6048 – Section 3.7:**

Original table:

Sample	Concentration added ( $\mu\text{M}$ )	Concentration found ( $\mu\text{M}$ )	Recovery (%)	RSD ( $n = 5$ )
Blood serum	4	3.89	97.49	0.06
Saliva	4	4.23	105.76	0.44



Correction:

Sample	Concentration added ( $\mu\text{M}$ )	Concentration found ( $\mu\text{M}$ )	Recovery (%)	RSD ( $n = 3$ )
Blood serum	4	3.89	97.49	0.06
	100	93.50	93.5	0.64
	300	304.79	101.6	0.93
Saliva	4	4.23	105.76	0.44
	100	97.72	97.72	0.39
	300	300.3	100.1	0.37

**Page 6048 – Section 4:**

Original text:

“... particularly in the monitoring of biochemical substances.”

Correction:

“... particularly in the monitoring of biochemical substances.

It is worth noting that while this work focuses on dopamine detection, the general concept of Cs-MoS<sub>2</sub>-modified electrodes can be adapted to sense other electroactive species. The combination of chitosan (Cs) and MoS<sub>2</sub> provides a versatile platform, as the intrinsic physicochemical properties of MoS<sub>2</sub> can be tailored with different functional groups, while chitosan acts as a stabilizing and biocompatible matrix. By further adjusting the electrode modification parameters, it should be possible to develop sensors capable of detecting a wider range of biomolecules, environmental pollutants, or pharmaceutical compounds. Future research efforts may explore different functionalization strategies or incorporate selective recognition elements, such as aptamers or molecularly imprinted polymers, thereby broadening the applicability of Cs-MoS<sub>2</sub>-modified electrodes for diverse analytical challenges.”

The Royal Society of Chemistry apologises for these errors and any consequent inconvenience to authors and readers.

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