Review of: "Critical Review on Carbon Nanomaterial Based Electrochemical Sensing of Dopamine the Vital Neurotransmitter"

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Potential competing interests: No potential competing interests to declare.

This manuscript presents an insightful overview of a significant topic for the field of electrochemical sensing. The detection of dopamine is of paramount importance in medical diagnostics, and the use of carbon nanomaterials in the fabrication of electrochemical bio/sensors offers tremendous potential for improving detection performance.

This article would benefit from improved organization and clarity, with a focus on the latest developments in the field. I consider it important for the authors to offer a more up-to-date perspective on electrochemical biosensors and sensors for dopamine based on carbon nanomaterials to ensure the review remains relevant to today's readers. I am also suggesting that the authors consider dividing the lengthy sections into subsections that are ended with a brief summary highlighting the key points emphasized.

Page 5 – Section 3: I suggest that the authors present the electrochemical techniques more clearly, specifically emphasizing the DPV (differential pulse voltammetry) and SWV (square wave voltammetry) variants of voltammetric methods, as these are widely used in electrochemical sensors due to their high sensitivity and ability to minimize background currents.

Section 3.1: The authors should mention other recognition elements beyond enzymes, such as antibodies, aptamers, or molecularly imprinted polymers, and compare their effectiveness in dopamine sensing. This may offer a broader perspective on detection methods for dopamine.

Page 6: The difference between electrochemical biosensors and simple electrochemical sensors is not clearly presented.

Both biosensors and chemical sensors use transducers to convert the interaction with the analyte into a detectable signal, typically in the form of current, voltage, or impedance changes. However, the key difference lies in the detection method: in biosensors, the detection is driven by biorecognition elements (such as enzymes, antibodies, or aptamers), which specifically bind to the target analyte. The authors should emphasize that typically in the case of biosensors, the product formed from the interaction between the analyte and the recognition element interacts with the electrode, generating an electrochemical signal. For electrochemical sensors, the electrochemical response (such as the current produced during oxidation or reduction) usually results directly from the electroactive analyte, without relying on a biorecognition element.

Page 7: The main roles of using carbon nanomaterials as electrode modifiers for the development of electrochemical

bio/sensors is not very clearly emphasized. This should be focused on their high surface area, which enhances sensor sensitivity; excellent conductivity, facilitating rapid electron transfer and improving signal accuracy; and strong electrocatalytic properties, which lower the overpotential needed for reactions, thereby improving the method's selectivity.

The discussion on pages 8-10, section 4, is, in my opinion, too lengthy and lacks conciseness. It could clearly benefit from greater conciseness to improve clarity, as the current length makes it harder to follow.

Section 4.1 should be clearly organized into several subsections, structured around the key roles of carbon nanomaterials as electrode modifiers in the development of electrochemical bio/sensors. A simple listing of previous attempts is difficult for the reader to follow and adds limited value to this review. A more structured discussion highlighting the role of the nanomaterials would improve clarity and provide a better understanding of the progress in this field. Additionally, considering the Introduction section of the article, a clear distinction between the developed devices as biosensors or chemical sensors would provide better clarity and organization.

The purpose of Section 4.2 is unclear, as the current title does not accurately reflect its content. A more suitable title should state that the section is addressing the selectivity issues in carbon nanomaterials (not only carbon nanotubes) - based electrochemical sensors for dopamine detection.