Silver-modified Laser Induced Graphene Electrodes for Electrochemical Non-Enzymatic Salivary Urea Sensing

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Abstract

The fabrication and development of silver dendrite modified Laser Induced Graphene (Ag-LIG) sensors for the electrochemical, non-enzymatic urea sensing from minimally processed human saliva is reported. The developed sensor demonstrated appreciable reproducibility, good sensitivity, low limit of detection, high selectivity which is confirmed by excellent recovery traits in urea spiked in simply diluted saliva samples, appreciable stability, and exhibited linear range encompassing clinically relevant (healthy/diseased) concentrations of salivary urea. Further, the sensor facilitates rapid detection in ~2 min, is readily integrable with smart phone, and is easily operatable without any prior training. Additionally, the real-time applicability of the Ag-LIG sensors was comprehensively validated by comparing its performance with the gold standard method, wherein the salivary urea measurements using the sensors exhibited excellent degree of agreement with the former. Further, user survey and testing by untrained volunteers gave away results with high accuracy and precision like those obtained by trained chemists, thus evidencing easy-usability of the sensor device. Lastly, the cost per sensor was calculated to be meagre 0.08 $, which is 40-80 times cheaper than existing commercial products, thereby emphasizing its immense economic benefits and lab-to-market translatability.

References

1. Alzahrani, K.A. AE Nagarathinam, T Dineshkumar, K Rajkumar, A Rameshkumar, TA Shruthi, Alzahrani, F. Alzahrani, S.P. Halawani, I. Halawani, Validation of Diagnostic Utility of Salivary Urea in Patients with Chronic Kidney Disease in Chennai: A Cross-Sectional Study, Niger. J. Clin. Pract. 22 (2019) 1070–1077. https://doi.org/10.4103/njcp.njcp

Figures

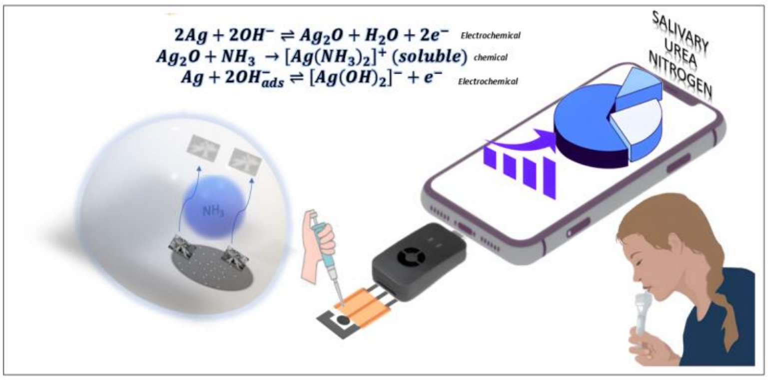

Figure 1: Salivary urea detection using hand-held device.