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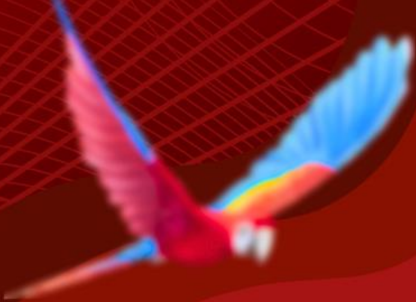

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Insights into *In Situ* electrogeneration of H_2O_2 in urine matrix using gas diffusion electrodes

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The quest for new technologies and catalytic materials capable of producing chemical oxidants has been a topic of considerable interest. Among these, the *In Situ* production of hydrogen peroxide (H_2O_2) offers significant advantages, particularly in decentralized treatments of complex matrices, by reducing constraints related to storage, transportation, and management of this reagent. H_2O_2 is a powerful and versatile chemical reagent that can act both as a reducer and an oxidizer. The *In Situ* generation of this oxidant can be achieved through the Oxygen Reduction Reaction (ORR) involving the transfer of 2 electrons [1]. Carbon materials have prominently featured due to their ability to selectively promote reactions. A notable example is the carbon-based Printex-L6 matrix, distinguished by its large surface area and functional groups acting as active sites [2,3]. These characteristics impart a hydrophobic nature to the material, making it a promising choice for various applications. In this study, gas diffusion electrodes (GDEs) were synthesized using Printex-L6 carbon (P-L6) for in situ generation of H_2O_2 aimed at enabling the production of this oxidant for subsequent use in degrading organic components of synthetic urine, specifically urea, uric acid, and creatinine. Electrogeneration of H_2O_2 was evaluated under different current densities (25, 50, and 100 mA cm^{-2}) in the inorganic salts present in synthetic urine and compared with electrogeneration in Na_2SO_4 at the same ionic strength. Experiments were conducted in a glass electrochemical cell equipped with a Ag/AgCl reference electrode, a dimensionally stable anode used as a counter electrode, and the GDE prepared as the working electrode positioned at the cell base. O_2 flow was fixed at 0.05 L min^{-1} and directly injected into the GDE. Quantification of H_2O_2 was performed by UV-Vis absorption spectrophotometry ($\lambda = 350$ nm) using ammonium molybdate. All experiments were performed in duplicate over 120 min, under mechanical stirring and constant temperature of 20 °C. Results revealed that, overall, the highest H_2O_2 generation occurred at a current density of 100 mA cm^{-2}, reaching a maximum concentration of 1253 mg L^{-1} in Na_2SO_4 medium. However, under the same conditions, H_2O_2 generation in salts from synthetic urine was 94.314 mg L^{-1}.

Comparing this electrogeneration among the supporting electrolytes, approximately 75% of H_2O_2 consumption in urine matrix salts can be attributed to the compositional complexity of this matrix. Besides Na_2SO_4, the synthetic urine composition included NaCl, Na_2HPO_4, and KCl, which significantly interfered with H_2O_2 generation and stability. Chloride ions (Cl^-) may catalyze H_2O_2 decomposition, leading to the formation of chlorine gas (Cl_2) and water; sulfate ions (SO_4^{2-}) may react with H_2O_2 to form persulfate (HSO_5^-); and phosphate ions (HPO_4^{2-}) may catalyze H_2O_2 decomposition, resulting in the formation of water and oxygen. These interactions can reduce H_2O_2 concentration in the solution. Moreover, the simultaneous presence of various ion types may result in secondary reactions that also affect H_2O_2 stability.

Thus, these results indicate that in situ generation of H_2O_2 in complex matrices such as synthetic urine is significantly influenced by the presence of inorganic components. Despite the high efficiency observed in Na_2SO_4, the presence of NaCl, Na_2HPO_4, and KCl in synthetic urine drastically reduces H_2O_2 concentration due to decomposition reactions. This study opens new frontiers for optimizing H_2O_2 generation systems, underscoring the importance of developing materials and experimental conditions that can mitigate the influence of inorganic interferents in complex matrices.

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