Gold nanoparticle decorated paper electrode assembles for sensor applications

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In recent years, paper-based sensor systems have been started over again to be used because of their unique properties such as low cost, biocompatible, disposable, flexible, easily prepared, and simple to use. In the literature, several applications of paper-based electrochemical sensors were reported for chemical industry fields, food safety, environmental, and clinical analysis. Furthermore, researchers focus on working with paper-based sensors as point-of-care (POC) diagnostics because of their eco-friendly behavior. Basically, a paper-based electrochemical sensor consists of a paper membrane as a substrate material, an electrode area, and two or three electrodes. In general, the electrode area is created by forming hydrophobic barriers on the paper substrate surface. Then, the two/three electrodes assemble can be fabricated by using various techniques.

Recently, different types of nanomaterials were reported in the literature to increase the surface area and enhance the conductivity of electrochemical sensors. Gold nanoparticles (AuNPs) are one of the most widely used nanomaterials with unique characteristics such as high surface energy and high surface area. Therefore, AuNPs can be used to serve an efficient conducting interface and unique catalytic activity for the construction of robust and sensitive electrochemical sensors.

We have fabricated the paper electrodes and modified them with nanomaterials. In our works, we have utilized the gold nanoparticles which were formed by using both chemical and/or electrochemical synthesis mechanisms. Subsequently, the modified paper electrodes have been used for various applications. Here, we focused on using the gold nanoparticle modified paper electrodes for the determination of ammonia via an electrochemiluminescence technique.

Recent Publications:

1. Torul H, Gumustas M, Urguplu B, Uzunoglu A, Boyaci IH, Celikkan H, Tamer U (2021) Disposable electrochemical flow cell with paper-based electrode assemble. J. Electroanal. Chem. 891: 115268.
2. Torul H, Yarali E, Eksin E, Ganguly A, Benson J, Tamer U, Papakonstantinou P, Erdem A (2021) Paper-based electrochemical biosensors for voltammetric detection of miRNA biomarkers using reduced graphene oxide or MoS2 nanosheets decorated with gold nanoparticle electrodes. Biosensors-Basel 11(7): 236.
3. Eksin E, Torul H, Yarali E, Tamer U, Papakonstantinou P, Erdem A (2021) Paper-based electrode assemble for impedimetric detection of miRNA. Talanta 225: 122043.

4. Chen L, Huang D, Zhang Y, Dong T, Zhou C, Ren S, Chi Y, Chen G (2012) Ultrasensitive gaseous NH3 sensor based on ionic liquid-mediated signal-on electrochemiluminescence. Analyst 137: 3514–3519.
5. Carrara S, Arcudi F, Prato M, De Cola L (2017) Amine-Rich Nitrogen-Doped Carbon Nanodots as a Platform for Self-Enhancing Electrochemiluminescence. Angew. Chemie. 129: 4835–4839.

Biography

Hilal TORUL is a research assistant of Pharmacy Faculty at Gazi University in Ankara, Turkey. She received her Ph.D. degree from Department of Analytical Chemistry, Gazi University in 2016. Her research focuses on paper-based electrodes, modified electrodes, enantiomer separations, magnetic and anisotropic nanoparticles, surface enhanced Raman scattering based assays, and paper based microfluidic analytical devices.