

UNIVERSITI TEKNOLOGI MARA

**COPPER, LEAD AND
DIPHENYLAMINE IN
GUNSHOT RESIDUE ANALYSIS
USING SCREEN PRINTED
CARBON ELECTRODE (SPCE)
AND GOLD COATED SPCE**

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ABSTRACT

Electrochemical analysis on screen printed carbon electrode (SPCE) is relatively simple, rapid and reliable tool inorganic compound identification such as copper in gunshot residue (GSR). SPCE is specially designed to cope with microvolumes of sample such as GSR sample due to its potential for miniaturization and facility of automation. It would be beneficial for the quantification of copper in GSR for a forensic analyst in the fastest way at the discharging area. The coating of gold on SPCE enhances the voltammetric performances towards detection of copper, lead and diphenylamine. The coupling of voltammetry with gold coated SPCEs allows the on-site preliminary test and improves the conventional method which capable to analyze GSR in the laboratory in the long period and have a risk of sample loss. The gold coated SPCE was swabbed directly on the shooter's arm immediately after discharging a firearm and the sample SPCE was analyzed using cyclic voltammetric method. The electrochemical performances of copper, lead and diphenylamine on bare SPCE and gold coated SPCE using voltammetric method were studied. Gold coated SPCE was characterized and optimized before field work. The voltammetric sensor responded to a series of 1 ppm to 100 ppm of copper solution shows gold coated SPCE increased the percentage of reproducibility about 5 % to 17 % in aspect of current density compared to bare SPCE due to their large effective surface area, effective catalysis and fast mass transport. GSR analysis was performed on Glock, Rifle Stryer AUG-A1 and Rifle Colt M16-A1 using cyclic voltammetry and Inductive Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) methods. The results obtained from cyclic voltammetric analysis show copper concentrations detected in Glock, Rifle Stryer AUG-A1 and Rifle Colt M16-A1 were 0.680 ppm, 1.349 ppm and 0.707 ppm respectively while the amounts of copper detected by ICP-OES analysis were 0.724 ppm (Glock), 1.432 ppm (Rifle Stryer AUG-A1) and 0.748 ppm (Rifle Colt M16-A1). The paired Student's t-test indicated that there was no significant difference between the results obtained from both methods at the 94 % confidence level. A *p*-value of less than 0.05 was considered significant. Therefore, it can be concluded that the proposed method is reliable and can be successfully applied to the copper determination in GSR analysis.

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