

## Silver Nanoparticle Modified Graphene Paste Electrode for the Electrochemical Detection of Lead, Cadmium and Copper

Shirley Palisoc<sup>1,2</sup>, Eldrin T. Lee<sup>1</sup>, Michelle Natividad<sup>\*1,2</sup> and Lotis Racines<sup>1,3</sup>

<sup>1</sup> Condensed Matter Research Laboratory, Physics Department, De La Salle University

<sup>2</sup> Condensed Matter Research Unit, CENSER, De La Salle University

2401 Taft Avenue, Manila, Philippines, 922

<sup>3</sup> Central Mindanao University, Maramag, Bukidnon, Philippines, 8714

\*E-mail: [michelle.natividad@dlsu.edu.ph](mailto:michelle.natividad@dlsu.edu.ph)

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Silver nanoparticle (AgNP) graphene paste electrodes were fabricated from graphene powder mixed with mineral oil and silver nanoparticles. Anodic stripping voltammetry (ASV) was utilized to simultaneously detect lead ( $\text{Pb}^{2+}$ ), cadmium ( $\text{Cd}^{2+}$ ) and copper ( $\text{Cu}^{2+}$ ). The optimized amounts of mineral oil and AgNP were 80 $\mu\text{L}$  and 2mg respectively. The calibration curve of the optimized electrode showed a strong line correlation between the heavy metal concentration and the reduction current for  $\text{Pb}^{2+}$ ,  $\text{Cd}^{2+}$ , and  $\text{Cu}^{2+}$ . In addition, the limit of detection is 17 parts per billion (ppb) for  $\text{Cd}^{2+}$ , 12 ppb for  $\text{Pb}^{2+}$  and 44 ppb for  $\text{Cu}^{2+}$ . The optimized electrode was tested on three commercial brands of Puerh tea. Copper metal ions,  $\text{Cu}^{2+}$ , were found in the tea samples. Lastly, atomic absorption spectroscopy was used to verify the results obtained from ASV.

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**Keywords:** Silver nanoparticle, graphene paste electrode, anodic stripping voltammetry, heavy metals

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