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Stripping voltammetric determination of palladium, platinum and rhodium in freshwater and sediment samples from South African water resources

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Stripping voltammetry as technique has proved to be very useful in the analysis of heavy and other metal ions due to its excellent detection limits and its sensitivity in the presence of different metal species or interfering ions. Recent assessments of aquatic samples have shown increased levels of platinum group metals (PGMs) in aquatic ecosystems, caused by automobile exhaust emissions and mining activities. The development of an analytical sensor for the detection and characterisation of PGMs were investigated, since there is an ongoing need to find new sensing materials with suitable recognition elements that can respond selectively and reversibly to specific metal ions in environmental samples. The work reported shows the successful application of another mercury-free sensor electrode for the determination of platinum group metals in environmental samples. The work reported in this study entails the use of a glassy carbon electrode modified with a bismuth film for the determination of platinum (Pt^{2+}), palladium (Pd^{2+}) or rhodium (Rh^{2+}) by means of adsorptive cathodic stripping voltammetry. Optimised experimental conditions included composition of the supporting electrolyte, complexing agent concentration, deposition potential, deposition time and instrumental voltammetry parameters for Pt^{2+}, Pd^{2+} and Rh^{2+} determination. Adsorptive differential pulse stripping voltammetric measurements for PGMs were performed in the presence of dimethylglyoxime (DMG) as complexing agent. The glassy carbon bismuth film electrode (GC/BiFE) employed in this study exhibit good and reproducible sensor characteristics. Application of GC/BiFE sensor exhibited well-defined peaks and highly linear behaviour for the stripping analysis of the PGMs in the concentration range between 0 and 3.5 μg/L. The detection limit of Pd, Pt and Rh was found to be 0.12 μg/L, 0.04 μg/L and 0.23 μg/L, respectively for the deposition times of 90 s (Pd) and 150 s (for both Pt and Rh). Good reproducibility was also observed and the practical applicability of the sensor was demonstrated with the analysis of environmental water and sediment samples.