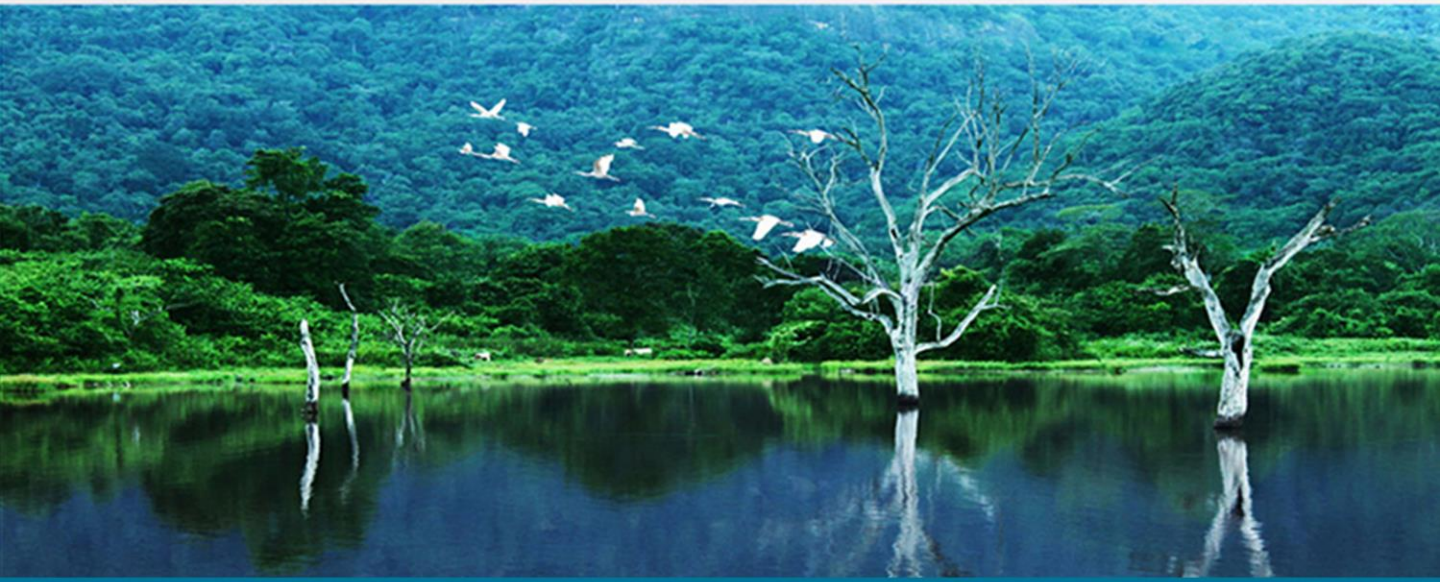
PROCEEDINGS

INTERNATIONAL SYMPOSIUM ON WATER QUALITY AND HUMAN HEALTH

2024

CHALLENGES AHEAD



History Culture Ecosystems Biodiversity Sustainability Livelihood Services Leisure Future

All begins with water

Postgraduate Institute of Science (PGIS) University of Peradeniya - Sri Lanka

23rd & 24th August 2024

Organized by the

BOARD OF STUDY IN ENVIRONMENTAL SCIENCE
POSTGRADUATE INSTITUTE OF SCIENCE (PGIS)
UNIVERSITY OF PERADENIYA, SRI LANKA

PR10

NANOELECTROCHEMISTRY FOR DETECTION OF CHROMIUM(VI) IN AQUEOUS ENVIRONMENT

X. Chen[1,2,3*], Y. Liu[1], Z-G. Wu[2] and R. Weerasooriya[2]

[1]*School of Resources and Environmental Engineering, Hefei University of Technology, Hefei, PR China*
[2]*National Centre for Water Quality Research, National Institute of Fundamental Studies, Kandy, Sri Lanka*
[3]*Institute of Industry and Equipment Technology, Hefei University of Technology, Hefei, PR China*

Chromium has several forms in the environment, with Cr(III) and Cr(VI) being the most persistent. Because of higher carcinogenic, mutagenic and oxidative properties, Cr(VI) is more dangerous than Cr(III). Therefore, accurate analysis of Cr(VI) in the environment is crucial. Electrochemical methods are among the most promising techniques for rapid and highly sensitive determination of Cr(VI) in water. Exploring materials with excellent electrocatalytic properties to construct sensitive interfaces is the key to improving the performance of electrochemical sensors. The Au/mpg-C_3N_4 and Au/UiO-66 nanocomposites were synthesized via a combination of the solvothermal method and the chemical reduction method, and the nanocomposites were used as the modification material for constructing the Cr(VI) electrochemical sensor. The experimental results showed that gold nanoparticles with an average diameter of about 25 nm were successfully reduced on the surface of UiO-66. The Au/UiO-66 nanocomposites-modified glassy carbon electrode (GCE) was used to detect Cr(VI) in aqueous environment through linear sweep voltammetry (LSV). Under the optimal conditions, the sensitivity of the sensor was 5.04×10^{-3} μA ppb^{-1}, and the minimum detection limit was 11.73 ppb over a wide linear dynamic range of 100-1200 ppb. The Cr(VI) concentration in the electroplating waste solution was determined to be 10.64 ppm by the procedure developed. The recovery was 92.4%, indicating that the Au/UiO-66/GCE sensor may be used to quantify Cr(VI) in electroplating wastewater. The Au/mpg-C_3N_4 nanocomposites, prepared via a photocatalytic reduction method, were also used for GCE modification. LSV and chronoamperometry were adopted to detect Cr(VI) in the water environment. Under the optimized conditions, the sensitivity of the sensor towards Cr(VI) is 2.20×10^{-3} μA ppb^{-1} with a wide linear dynamic range of 100-1000 ppb, and the minimum detection limit of 14.7 ppb. The sensor has good repeatability, reproducibility, and anti-interference performance. The content of Cr(VI) in the tannery wastewater calculated, using this sensor, was 376 ppb, which was similar to the ICP-OES result (386 ppb) with a recovery rate of 97.4%. Additionally, the Au/mpg-C_3N_4 nanocomposite modified the commercial screen-printed electrode (SPE) with industrial mass production was used to evaluate the practical applications of Au/mpg-C_3N_4 nanocomposite for on-site monitoring of Cr(VI) in the industrial waste liquid. The results show that the Au/mpg-C_3N_4/SPE sensor has a high sensitivity towards Cr(VI) (3.07×10^{-2} μA ppb^{-1}), and the Cr(VI) in real leather wastewater and plating wastewater can also be accurately detected.

Financial support from the National Natural Science Foundation of China (Grant No. 21777164) is acknowledged.

Keywords: Chronoamperometry, Glassy carbon electrode, Nanocomposite, Sensor, Voltammetry

xingchen@hfut.edu.cn