

Selectiveness of copper and polypyrrole modified copper electrodes for nitrate and nitrite electroreduction: a comparative study and application in ground water

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Chronoamperometry technique was performed to reduce nitrate and nitrite contamination, using copper (Cu) and polypyrrole (Ppy) modified copper (Ppy/Cu) electrodes in the simulated solution and real groundwater, sampled at some critical polluted areas in Ho Chi Minh City.

The Ppy/Cu electrodes were prepared on copper substrate by electrochemical oxidation of pyrrole in oxalic and salicylic acids and their buffer solutions. The modification conditions affect the morphology and performance of the Ppy/Cu electrodes. In addition, the optimal electrochemical parameters for modified electrodes vary in the dependence on the electrolyte solutions.

For simulated 100 mg/L nitrate solutions, the copper electrode showed the best catalytic activity for nitrate reduction (more than 40% in 3 h) in comparison with modified Ppy/Cu electrode (less than 20% in the same time). However a large amount of unwanted nitrite by-product (> 60% of reduced nitrate) was formed on Cu, while less than 2% of reduced nitrate converted to nitrite on Ppy/Cu electrodes. The modified Ppy/Cu electrodes perform selective and stable catalytic effect for the nitrite reduction.

Nitrate, nitrite and ammonium contamination in groundwater at six polluted areas in Ho Chi Minh City was analyzed, following the AOAC, ASTM, NIOSH standards by photometric and ion-chromatographic methods (NIOSH 6015, NIOSH 6014/ASTM 1607, ASTM D 1426, ASTM 3867). Binh Hung Hoa cemetery, Phan Xich Long and Linh Tay settlements were placed on alert with the nitrate concentration exceeding the maximum contaminant level (MCL) for nitrate measured as nitrogen 10 mg/l (established by EPA) by 77%, 26% and 23%, and with the ammonium concentration in 6.5, 11.0 and 1.6 times higher than the MCL 0.4 mg/l ammonium-nitrogen, respectively. Almost all studied ground water samples were polluted severely by ammonium.

The electroreduction of nitrate and nitrite compounds in the groundwater samples using Ppy/Cu electrodes was effectively with a considerable low formation of unwanted nitrite and ammonium products.

Key words: copper electrode, electrochemical reduction, groundwater, Ho Chi Minh City, nitrate, nitrite, polypyrrole.