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ARRAYS OF COPPER NANOWIRE ELECTRODES FOR THE SENSITIVE ELECTROANALYSIS OF NITRATE

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Major anthropogenic sources of nitrate in food and the environment are associated to inorganic fertilizers, food preservatives and other chemicals. Toxicity of nitrate to humans is related to its ability to oxidize hemoglobin (Hb) to methemoglobin (metHb). Nitrate can also act as precursor of nitrite whose carcinogenic or congenital malformation effects are known. The limit of concentration for nitrate in drinking water indicated by the World Health Organization (WHO) is 50 mg L^{-1} (10 mg L^{-1} for newborns) [1].
Among the analytical methods suitable to determine nitrate, electrochemical ones are very attractive since they are suitable for in-field and decentralized monitoring. Copper electrodes are often used to this aim since this metal presents interesting electrocatalytic properties towards nitrate reduction [2].
In this context, here we study possible improvements to the electrochemical analysis of nitrate by taking advantage of the detection capabilities of ensembles of copper nanowire electrodes (CuWNEEs).
CuWNEEs are prepared via template electrodeposition of copper within the nanopores of track-etched polycarbonate (PC) membranes. Three different preparation methods are compared which differ for the way used to contact the PC membrane with a flat disk Cu electrode used as supporting material. The best results in terms of sensor durability and reproducibility are achieved by pre-sputtering a thin gold film on the templating membrane and exploiting the adhesion property and ionic conductivity of a thin Nafion interlayer. The CuWNEEs are carefully characterized by electrochemical and SEM-EDS methods [3]. The voltammetric reduction of nitrate at CuWNEEs is characterized by a well-resolved cathodic peak at approximately -0.680 V vs Ag/AgCl. The detection limit by LSV is 1.7 μM and the dynamic range is 10-400 μM. Analytical results obtained with the CuWNEE sensor for nitrate analyses in mineral water samples compare satisfactorily with those achieved by standard chromatographic or spectroscopic methods.

[1] American Public Health Association (APHA)
Standard Methods for the Examination of Water and Wastewater
(18th ed.) American Public Health Association, Washington, DC (1992).
[2] M.J. Moorcroft, J. Davis, R.G. Compton, Talanta, 54, 2001, 785.
[3] A.M. Stortini, L.M. Moretto, A. Mardegan, M. Ongaro, P. Ugo, Sens. Act. B: Chem., 207(2015) 186-192.