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Enhanced Electrochemical Detection of Molybdenum Using Confinement Strategies and Scanning Electrochemical Microscopy

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Sensitive detection of molybdenum (Mo) is essential due to its biological importance and potential toxicity. An electrochemical method was developed based on an EC' (electrochemical-catalytic) mechanism between molybdate and bromate, with enhanced sensitivity achieved through species confinement using Scanning Electrochemical Microscopy (SECM). A thin-layer cell was formed by positioning a 5 µm-radius carbon microelectrode close to a conductive substrate, amplifying the cathodic current via Mo(VI) regeneration. The effect was intensified with microelectrodes of higher RG (ratio of the glass radius to fiber radius) values, reaching a 110% current increase for RG = 9 (Figure 1). This confinement enabled molybdate detection in the 0.5–10 µmol L^{-1} range, with a limit of detection of 240 nmol L^{-1}. Validation using synthetic urine confirmed the method's accuracy and applicability to complex samples.

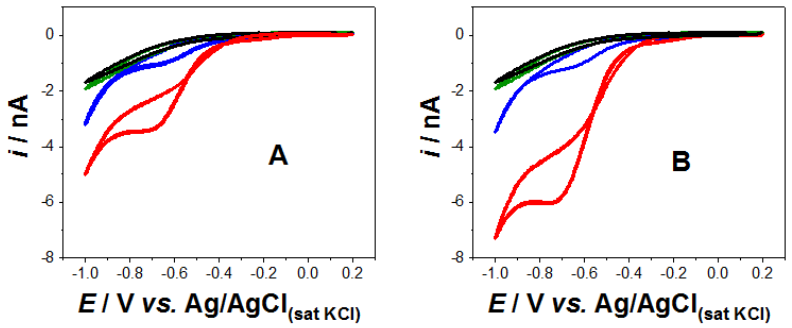

Figure 1 - Cyclic voltammograms recorded with a carbon microelectrode (r = 5 µm and RG = 9) positioned in the bulk solution (A) and at 8 µm from a conductive substrate in an SECM configuration (B). Acetate buffer at pH 3.7 in absence (black) and presence of 250 µmol L^{-1} bromate (green), 10 µmol L^{-1} molybdate (blue), and 10 µmol L^{-1} molybdate + 250 µmol L^{-1} bromate (red). Scan rate: 50 mV s^{-1}.

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References:

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