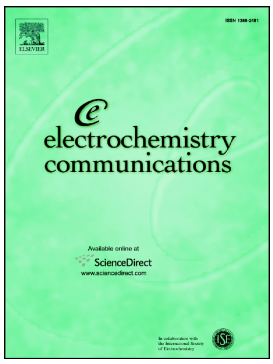

Heavy metal ion detection on a microspot electrode using an optical electrochemical probe

Santanu Roy, Abhijeet Prasad, Rahul Tevatia, Ravi F. Saraf

PII: S1388-2481(17)30329-6
DOI: doi:10.1016/j.elecom.2017.11.021
Reference: ELECOM 6090

To appear in: *Electrochemistry Communications*

Received date: 17 October 2017
Revised date: 19 November 2017
Accepted date: 21 November 2017

Please cite this article as: Santanu Roy, Abhijeet Prasad, Rahul Tevatia, Ravi F. Saraf , Heavy metal ion detection on a microspot electrode using an optical electrochemical probe. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Elecom(2017), doi:10.1016/j.elecom.2017.11.021

Heavy metal ion detection on a microspot electrode using an optical electrochemical probe

Santanu Roy[†], Abhijeet Prasad[†], Rahul Tevatia, Ravi F. Saraf[*]

Department of Chemical and Biomolecular Engineering, University of Nebraska, Lincoln, NE 68588; [†]Equal contribution; *rsaraf2@unl.edu

Abstract

Electrochemical sensors can be used to create portable, attractive, high-sensitivity devices to detect heavy ions in water at a reasonable cost. A novel method of measuring local redox on an electrode using the differential reflectivity measured on an approximately 6 micron diameter spot using a He/Ne laser beam is described. Field focusing and electrode modification enhance the sensitivity, making the method ideal for miniaturization and multiplexing multiple analytes on a monolith electrode. The method is demonstrated by detecting Pb, Hg, and As ions at ppb and ppt levels.

Keywords: Heavy metals; electrochemical analysis; electrode size; dielectrophoretic effect; water pollution; electro-optics

1. Introduction

With ever-decreasing sources of water for the growing world population, the search for new sources and need to recycle water have made the issue of heavy metal ion contamination a ubiquitous problem and intensified the need for new detection systems, in terms of sensitivity, specificity, and portability. Toxicity of heavy metal ions is well documented [1-3] with several toxic metals, such as As, Cd, Pb, and Hg, having no known biological function [4]. Heavy metal ions are toxic to the reproductive organs of females [5] and males [6], and some are also carcinogens [7]. Concentrations of Pb, Hg, and As at ppb levels in a normal human body pose serious health hazards, such as plumbism, hypertension, emphysema and even cancer, with chronic, irreversible damage to organs such as kidneys, skeletal muscles, and soft tissues [8]. Highly sophisticated methods, such as inductively coupled plasma–mass spectroscopy (ICP–