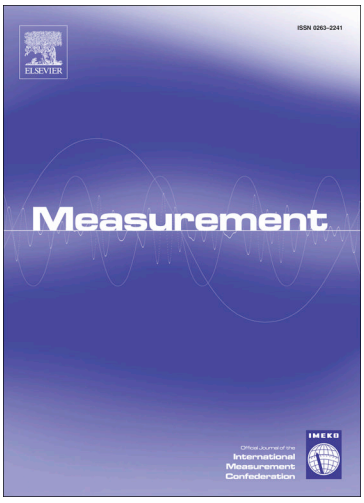

Optical fibre turn-on sensor for the detection of mercury based on immobilized fluorophore

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PII: S0263-2241(18)30084-8
DOI: https://doi.org/10.1016/j.measurement.2018.01.071
Reference: MEASUR 5246

To appear in: *Measurement*

Received Date: 15 August 2017
Revised Date: 28 November 2017
Accepted Date: 31 January 2018

Please cite this article as: S. Ruan, H. Ebendorff-Heidepriem, Y. Ruan, Optical fibre turn-on sensor for the detection of mercury based on immobilized fluorophore, *Measurement* (2018), doi: https://doi.org/10.1016/j.measurement.2018.01.071

Optical fibre turn-on sensor for the detection of mercury based on immobilized fluorophore

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Abstract

An optical fibre turn-on fluorescent sensor for the detection of mercury ions has been developed based on the use of immobilized organic fluorophore Rhod-5N. When the fibre was only used to deliver excitation laser and collection signal by dipping it into the mixture solution of the fluorophore and mercury ions, the detection limit was found to be as low as 0.3 ppb in aqueous solution, which is 10 times lower than that previously reported with both excitation source and fluorescence delivered by free space. For the fibre tip sensor with the fluorophore functionalized onto the fibre tip using a silica sol-gel film, it was found that higher Rhod-5N concentrations result in a more sensitive fluorescent response but a higher detection limit of 25 ppb in filtered river water. The portable features of this fibre probe are promising for online remote monitoring of mercury ions in water.

Keywords

Mercury ions, optical fibre, organic fluorophore Rhod-5N, dip coating.

Introduction

Contamination of the environment with heavy metal ions has been an important worldwide concern for decades. Mercury is a known environmental pollutant routinely released from coal-burning power plants, oceanic and volcanic emissions, gold mining, and solid waste incineration.[1] The general population is primarily exposed to mercury *via* food, fish being a major source of methyl mercury exposure, and dental amalgam.[2] Acute mercury exposure may give rise to lung damage. Chronic poisoning is characterized by neurological and psychological symptoms, such as tremor, changes in personality, restlessness, anxiety, sleep disturbance and depression.[3]

To meet the requirements of sensitivity, specificity and reusability, much effort has been devoted towards the design of sensing systems for heavy metal ions, including sensors based on organic chromophores[4-6], fluorophores[6] and conjugated polymers[7]. Among light emission techniques, organic fluorescence has been widely used for the determination of heavy metals in environmental samples.[8-10] An important feature of the sensing systems based on fluorescence is highly sensitive detection compared to absorbance-based techniques. While light absorbance is measured as the intensity difference between light passing through the reference and the sample, in fluorescence measurement, the intensity is directly measured. Sensors based on metal ion induced changes in fluorescence appear to be particularly attractive, and they are one of the first choices because of the simplicity and the low detection limits that may be achieved by