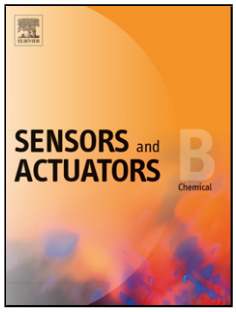

Title: Carbon dioxide measurements using long period grating optical fibre sensor coated with metal organic framework HKUST-1

Authors: Jiri Hromadka, Begum Tokay, Ricardo Correia, Stephen P Morgan, Sergiy Korposh

PII: S0925-4005(17)31706-9
DOI: http://dx.doi.org/10.1016/j.snb.2017.09.041
Reference: SNB 23132

To appear in: *Sensors and Actuators B*

Received date: 4-3-2017
Revised date: 4-9-2017
Accepted date: 7-9-2017

Please cite this article as: Jiri Hromadka, Begum Tokay, Ricardo Correia, Stephen P Morgan, Sergiy Korposh, Carbon dioxide measurements using long period grating optical fibre sensor coated with metal organic framework HKUST-1, Sensors and Actuators B: Chemicalhttp://dx.doi.org/10.1016/j.snb.2017.09.041

Carbon dioxide measurements using long period grating optical fibre sensor coated with metal organic framework HKUST-1

Jiri Hromadka[1,2], Begum Tokay[3], Ricardo Correia[1], Stephen P Morgan[1] and Sergiy Korposh[1]

[1]*Optics and Photonics Group, Faculty of Engineering, University of Nottingham, University Park, Nottingham NG7 2RD, United Kingdom*

[2]*Institute for Environmental Studies, Faculty of Sciences, Charles University in Prague, Benátská 2, CZ 12843 Praha 2, Czech Republic*

[3]*Chemical and Environmental Engineering Department*, *Faculty of Engineering, University of Nottingham, University Park, Nottingham NG7 2RD, United Kingdom*

Research Highlights

- An optical fibre long period grating CO_2 sensor coated with HKUST-1
- In-situ crystallization and layer by layer techniques of HKUST-1 thin film synthesis are compared
- 2 μm and 55 nm thickness for the film deposited using in-situ crystallization and layer by layer (40 layers) approach
- The film containing 40 layers showed detection limit of 401 ppm

Abstract

An optical fibre long period grating (LPG) based carbon dioxide (CO_2) sensor coated with HKUST-1, a material from the metal organic framework family, functional coating is presented. In-situ crystallization and layer by layer (LbL) techniques of HKUST-1 thin film synthesis are compared in terms of the feasibility of the deposition procedure (time and cost efficiency) and the sensitivity of the film to CO_2. The sensing mechanism is based on the measurement of the change of the refractive index (RI) of the coating that is induced by the penetration of CO_2 molecules into the HKUST-1 pores. The HKUST-1 film was characterized by scanning electron microscopy. The thickness and refractive index (RI) of the 10, 20 and 40 layers thick films were determined using ellipsometry. The crystallinity of the films was examined by X-ray diffraction pattern (XRD). While no response to CO_2 was observed for the sensor coated using the in-situ crystallization technique, an LPG modified with 10, 20 and 40 layers of HKUST-1 films using LbL method upon exposure to CO_2 in the range of 500 ppm to 40,000 ppm showed good