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

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Research Highlights

- An optical fibre long period grating CO₂ 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 (CO₂) 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 CO₂. 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 CO₂ 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 CO₂ 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 CO₂ in the range of 500 ppm to 40,000 ppm showed good

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