

## Accepted Manuscript

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PII: S0925-4005(18)31013-X  
DOI: <https://doi.org/10.1016/j.snb.2018.05.106>  
Reference: SNB 24762

To appear in: *Sensors and Actuators B*

Received date: 8-12-2017  
Revised date: 5-5-2018  
Accepted date: 18-5-2018

Please cite this article as: Dejun Liu, Rahul Kumar, Fangfang Wei, Wei Han, Arun Kumar Mallik, Jinhui Yuan, Shengpeng Wan, Xingdao He, Zhe Kang, Feng Li, Chongxiu Yu, Gerald Farrell, Yuliya Semenova, Qiang Wu, High sensitivity optical fiber sensors for simultaneous measurement of methanol and ethanol, *Sensors and Actuators B: Chemical* <https://doi.org/10.1016/j.snb.2018.05.106>

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# High sensitivity optical fiber sensors for simultaneous measurement of methanol and ethanol

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## Highlights

- High sensitivity volatile organic compounds (VOCs) sensors based on a tapered small core single mode fiber (TSCSMF) and a microfiber coupler (MFC) are reported.
- Silica based materials containing immobilized Nile red prepared by sol-gel method with two different recipes (recipe I and recipe II) are investigated.
- The experimental results show that the sensor based on an MFC with recipe I has detection limits of ~77 ppb and ~281 ppb to ethanol and methanol respectively.
- Both sensors are demonstrated fast response times of less than 5 minutes, while the recovery times varied from 7 minutes to 12 minutes.
- In addition, simultaneous measurement of ethanol and methanol by using another TSCSMF based sample (7.0  $\mu\text{m}$ ) coated with recipe II.

## Abstract

High sensitivity volatile organic compounds (VOCs) sensors based on a tapered small core single mode fiber (TSCSMF) and a microfiber coupler (MFC) are reported. The TSCSMF had a waist diameter of ~5.1  $\mu\text{m}$  and the MFC had a waist diameter of ~1.9  $\mu\text{m}$  each and both were fabricated using a customized microheater brushing technique. Silica based materials containing immobilized Nile red prepared by sol-gel method with two different recipes (recipe I and recipe II) are investigated. Initially recipe I based coating materials were applied to the surfaces of the TSCSMF and MFC. The experimental results show that the sensor based on an MFC shows much better sensitivities of -0.130 nm/ppm and -0.036 nm/ppm to ethanol and methanol than those of the TSCSMF based sensor. The corresponding minimum detectable concentration change of the MFC based sensor are calculated to be ~77 ppb and ~281 ppb to ethanol and methanol respectively. Both sensors are demonstrated fast response times of less than 5 minutes, while the recovery times varied from 7 minutes to 12 minutes. In addition, another TSCSMF based sample (~7.0  $\mu\text{m}$ ) coated with a mixed layer of sol silica and Nile red prepared by recipe II was fabricated to achieve simultaneous measurement of ethanol and methanol, employing a second-order matrix approach.

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