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## Fiber-optic heterodyne frequency modulation sensor for volatile organic compounds (VOCs) detection

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In our study, we proposed a fiber-optic heterodyne frequency modulation sensor to detect volatile organic compounds (VOCs) gas such as benzene and acetic acid. A solvatochromic dye, 4-Amino-N-Methylphthalimide (4-ANMP) incorporated into a polymer [polyvinyl chloride (PVC)] and N,N-Dimethylacetamide (DMAC) solution to make the sensing membrane and was deposited on the side-polished fiber-optic device by spin coater to make the fiber-optic sensing element. According to heterodyne frequency modulation technique, the time period of the sensing signal shift with respect to the reference signal when the solvatochromic dye containing sensing membrane comes into the contact VOC gas and this shift occurs due to change the refractive index of the polymer planar waveguide. The phase shift difference between the sensing and reference signals is measured at the room temperature and recorded using an oscilloscope. Benzene and acetic acid at concentrations from 0 to 1000 ppb was used to observe the sensing ability of the proposed sensing system. The sensitivity of the proposed VOC gas sensor for benzene and acetic acid was 3.22  $\mu$ s and 1.44  $\mu$ s, respectively. The sensor offers a linear sensing performance over its wide dynamic range and its correlation coefficient  $R^2$  for benzene and acetic acid gas was 0.997 and 0.996, respectively. The performance of the proposed sensing system was compared with the wavelength shift and pulse width modulation (PWM) VOC gas sensing system with respect to sensitivity, linearity, dynamic range width, and response and recovery times. We found that the proposed VOC gas sensing system has better performance.

### Biography

Md Rajibur Rahaman Khan received both BSc (Honours) and MSc with first class in Applied Physics, Electronics and Communication Engineering from Islamic University, Kushtia, Bangladesh in 2003 and 2005, respectively. He obtained his PhD degree in Electronics Engineering from Kyungpook National University, Daegu, South Korea in 2014. He is currently a Post-doctoral Researcher at the School of Electronics Engineering, Kyungpook National University, since 2014. He has published 8 research articles in international journals of repute. He also has published more than 13 international conference papers. His research interests include fiber-optic gas and taste sensors, interdigitated electrode based sensors, and biosensors.

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