Applications of the Cholesteric Liquid Crystal (CLC) Sensor to Rapidly Measure the Volatile Organic Compounds in the Atmosphere Environment

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The Volatile Organic Compounds (VOCs) are one of the most important air pollutants emitted from industries. Some of the emitted Volatile Organic Compounds are carcinogenic which are harmful the health of both the human and environments. Typically, the concentrations of the VOCs in the atmosphere environment were measured by a Gas Chromatography (GC). However, these methods are expensive, complex, and difficult to be used for on-line application. According to the literatures, there is a lack of simple and economy detection methods for rapidly measure the VOCs in the atmosphere environment. The purpose of this study was to develop a Cholesterol Liquid Crystal (GLC) sensor for rapidly measure the concentrations of volatile organic compounds (VOCs) in the atmosphere environment.

According to the experimental results of this study, the physical directions of the GLC molecules will be changed when the prepared CLC sensor contact with the VOCs, and resulting the color on the surface of the CLC sensor changed from a Green or Red color to colorless, therefore, the target VOCs can be identified. By using a UV-VIS spectrophotometer or digital image analysis, the color can be identified. Moreover, it was also found that the color change from Green to colorless is rapid when contact with higher concentrations of VOCs. The durations of color change from Green to colorless was also found presented a liner relationship with the concentrations of VOCs, therefore, the concentrations of VOCs in the atmosphere environment can be identified. The CLC sensor was arranged to contact the VOCs by the controlled of different temperatures of 22±0.3^{0}C, 24± 0.3^{0}C, 27 ±0.3^{0}C and 30± 0.3^{0}C, respectively. The concentrations of VOCs can be measured from 19,955 ppm to 36,585 ppm with a linear relationship of R^2 =0.97 at 22±0.3^{0}C, the concentrations of VOCs from 9,978 ppm to 26,607 ppm (R^2=0.97) can be measured the GLC sensor at 24±0.3^{0}C, the concentrations of VOCs from 26,607 ppm to 43,237 ppm (R^2 =0.90) by the GLC sensor at 27±0.3^{0}C, as well as the concentrations of VOCs from 8,315 ppm to 19,955 ppm (R^2=0.90) by the GLC sensor at 30±0.3^{0}C. As a result, the VOCs concentrations can be easy and rapid identified by the prepared CLC sensor using the analysis data from both UV-VIS and image analysis.

Keywords: Cholesteric Liquid Crystal, sensors, Volatile organic compounds(VOCs), Image analysis

