Enhanced CO₂ Sensing with Bromothymol Blue Doped Electrospun Nanofibers in Presence of Perfluorocompounds and Green Chemistry Reagents; Ionic Liquids

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In this study, a new optical CO₂ sensor based on the spectrophotometric signal changes of the ion pair form of bromothymol blue in nanofibrous materials is proposed. Sensing slides were fabricated from ethyl cellulose polymer by electrospinning technique. Utilization of electrospun polymer fibers for optical sensor designs was firstly proposed by our working group and enhanced gaseous sensing [1]. In this study, we have used for the first time, the pH indicator bromothymol blue in electrospun fibers for CO₂ gas sensing and we have also examined the effect of some additives; ionic liquids and perfloro compounds to CO₂ response. By this way we have combined the advantages of nanofibers with the ionic liquids and perfloro compounds. Nanofibers supply high surface area to volume ratio. Ionic liquids are known as green chemistry reagents and act as a plasticizer giving flexibility to the nanofiber polymer; besides they increase the conductivity of the polymer by increasing the ionic groups in the matrix and facilitates the fabrication of fibers. It should be also noted that the solubility of CO₂ in ionic liquids is about 10 to 20 times as that observed in the conventional solvents, polymer matrices or in water [2]. Perfloro compounds also increase the solubility of CO₂ gas in the matrix and enhance the response of the sensing agent. In the first stage of the study, determination of the acidity constant (pKa) of the ion pair of BTB in the employed nanofibrous matrix. In the second stage, response of the sensor composition to gaseous and dissolved CO₂ was investigated and the response in presence and absence of ionic liquid and perfluoro compound has been evaluated. The nanofiber structure together with ionic liquid and perfluoro compound enhanced the response from 35 % to 56 % for 5 % of CO₂ gas. The stability of ion pair form of bromothymol blue in the employed matrix materials was excellent and regeneration of the matrix with nitrogen gas was performed without any loss of efficiency. The response times of the sensing fibers were quite short and in second orders.

KEYWORDS: CO₂ sensing, electrospun nanofibers, bromothymol blue, ionic liquid

REFERENCES: