Abstract

This research work is mainly based on the development of polymer membranes having chemically attached surface functional sites as suitable sensor materials for the sensing of different basic taste substances, short chain aliphatic alcohols and drinking water brands. As the sensitivity of a sensor largely depends on the magnitude of interaction between the sensor material surface and the sensing objects in both liquid and vapor phases, we developed a series of polymer membranes with varying surface functional sites in order to sense the above maintained analytes in different magnitudes. Functional groups present in the polymer membranes, surface morphologies and thermal stabilities of them were characterized by UV-vis., FT-IR, XRD, SEM, TEM, TG and DSC analyses. All the membranes have sufficient mechanical strength to be used for the preparation of polymer membrane electrode based sensor device. Sensing device was fabricated by using these functional polymer membranes as membrane electrodes and a Ag/AgCl reference electrode in liquid phase sensing of different analytes. Two probe technique of resistivity measurement of the developed functional conducting polymer membranes was followed for vapor phase sensing of aliphatic alcohols. As expected, polymer membranes showed discriminatory nature of response patterns towards each analyte under study at varying range of concentrations. Repeatability of response patterns of a particular polymer membrane is also identical up to four consecutive cycles of sensing measurements. Polymer membranes showed very low detection threshold concentration values for different sensing analytes. Principal component analysis (PCA) of sensing response data of the polymer membranes showed good discrimination and clustering for different analytes. A prototype liquid phase sensing device (E-tongue) was also developed which had a specially designed sensor array based on functional polymer membrane electrodes and the device was equipped to acquire the signals generated by such sensor array and to convert the data suitably, for digital processing. This E-tongue device is user friendly, easy to operate and can easily be maintained. The developed polymer membranes have excellent mechanical stability for fabrication of membrane electrodes and shelf life which are essential for an ideal sensor device. The methodologies of sensing used in this invention are objective, real time, inexpensive and practically deployable for various food and agricultural applications.

Key words: Functional polymer membranes; Membrane characterization; Sensing devices; Response potential; Resistivity; Response patterns; Repeatability; PCA.