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Determination of the concentration of glucose-ethanol-water mixtures using spectroscopic surface plasmon resonance on smartphone

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The determination of the refractive index (RI) and concentration of ternary mixture of glucose, ethanol and water is demonstrated by smartphone platform based on the detection of the refractive index by using surface plasmon resonance (SPR) principle. The optical coupler has been specially designed for coupling the light from smartphone screen to excite SPR on the thin gold layer in contact with solutions and to guide the reflected light to the smartphone camera used as the detector. For this work, the RIs of glucose and ethanol solution was determined by using image processing technique; the captured images of each individual solution were processed to the SPR spectra which indicates the significantly different SPR shift corresponding to the RI changes. In order to estimate the individual concentration of ternary mixture, at least two independent calibration equations are needed. Hence, two color light sources with different color intensity denoted as color1 (R=255, G=0, B=0) and color2 (R=255, G=100, B=0) were used to construct the calibration equations of two binary solutions. Calibrations ware carried out using four ethanol-water and glucose-water solutions which were providing a linear response in the refractive index range of 1.341–1.361 RIU (R2 = 0.977-0.992) with the resolution of 0.14 mL/dL, and 0.04 g/dL for ethanol-water and glucose-water solutions, respectively. As a result, the estimated concentration errors for each element of the prepared ternary solution were found to be less than 5%. Accordingly, our work demonstrates the successful experiment for the determination of concentration of ternary mixture on unmodified smartphone which provides a simple and reliable portable device.

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