

Abstract of the Thesis

Title of the Thesis: Impedimetry Based Urea Sensing Device

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This work presents three different types of urea sensors to measure concentration of urea present in aqueous and blood samples. All these sensors are developed based on impedimetry sensing where the AC impedance of sample solution is measured and based on the impedance magnitude concentration of sample, urea is assessed. First, the work presents a multi-use, urea sensor for aqueous samples for the range 5 mg/dL to 5 g/dL. The sensor is fabricated by binding urease layer on Cu-epoxy stick using PMMA, and encapsulating the entire probe with DQN-60 polymer. Thus the electrodes here also act as the sensing bed. The sensor is robust, lightweight and compact. It is suitable for portable meter to be used in field. The sensor has a shelf-life more than 6 months, operation cycle more than 150 and accuracy 6.5% (in terms of RMS of full scale error). Extensive experimentation has been carried out over a year to determine sensor specifications. Such study has also helped to determine suitable coating composition and sensing guidelines.

The work also present a disposable aqueous urea sensor, for measuring urea in aqueous sample for the range 1 mg/dL to 1 g/dL with an accuracy of 2.5%. This bio-degradable sensor is fabricated by forming a PMMA-urease layer on Cu tape with paper base and encapsulating the tape with wax. The work also describe a disposable blood urea sensor from the range 1 mg/dL to 75 mg/dL which covers the range of blood urea concentration of human. The blood urea sensor is fabricated on paper base with wax-urease layer and graphite electrodes. Using this sensors the blood urea can be assessed directly from the whole-blood. The shelf-life of such single-use sensor is approximately 6 months.

The work also incorporates design of suitable electronic interfaces for each reported sensors. Together they make prototypes of inexpensive portable urea meters which can be used for water urea monitoring or point-of-care medical diagnosis. A part of the proposed work also includes development of electrical equivalent model of presented urea sensors. The modelling is carried out using EIS technique with the help of LEVMW software and MATLAB based programs. Based on this equivalent model, suitable measurement frequency and measuring instant are determined to achieve good repeatability and sensitivity.