

INCREASED SENSITIVITY OF ENZYME-BASED AMPEROMETRIC
GLUCOSE BIOSENSORS AND THEIR APPLICATION AS
TIME-TEMPERATURE INTEGRATORS

Abstract

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This dissertation concerns the development of amperometric glucose oxidase-based biosensors using electrochemically-generated polymers as enzyme immobilization matrices. A potential novel application of amperometric enzyme biosensors as time-temperature integrators for food pasteurization is presented.

Chapter One gives an introduction to amperometric enzyme biosensors and time-temperature integrators and background to supplement the four manuscripts that form the main body of this dissertation.

Chapter Two reviews the different types of biosensors and their applications to the food and agricultural industries (Encyclopedia of Agricultural Food and Biological Engineering, Heldman, D. Editor. Marcel Dekker Inc. 2003 pp. 119-123).

Chapter Three describes a method for simultaneously determining film permeability to H_2O_2 and substrate surface area coverage of overoxidized polypyrrole films. The effects of polymer growth potential, electrolyte concentration, monomer concentration, glucose oxidase concentration and film thickness are discussed. (Synthetic Metals, 2004, 142, (1-3) 71-79).

In Chapter Four, platinum platinization conditions were improved to produce a 60-fold increase in electrode sensitivity using glucose oxidase immobilized in poly-*o*-phenylenediamine. Glucose oxidase concentration was adjusted to obtain maximum current response. Potentiostatic platinization at -100 or -50 mV resulted in mechanically stable deposits unlike the commonly used -250 mV. Large concentrations of glucose oxidase did not inhibit the electropolymerization of *o*-phenylenediamine. (Submitted in revised form to the Journal of Electroanalytical Chemistry).

Chapter Five is a manuscript, that describes a novel exogenous time-temperature integrator (TTI) based on an amperometric glucose oxidase biosensor. The TTI consists of an enzyme entrapped within an electrochemically generated poly-*o*-phenylenediamine (PoPD) thin film deposited on the interior wall of a platinized stainless steel capsule. After thermal treatment, the TTI is mounted in a continuous flow system and connected to a potentiostat for amperometric detection of residual enzyme activity. A measurement is completed within five min of extracting the device from the heat treatment process. (Will be submitted for publication in the Journal of Agricultural and Food Chemistry).

Diagrams of instruments built for this research, LabVIEW computer programs and a collection of photographs of the pieces of equipment used for this research appear in six appendices.