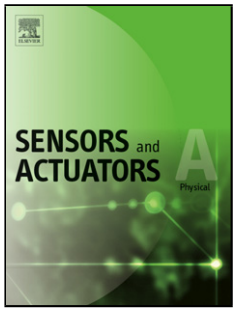

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Analysis of temperature and pH shifts on the impedance characteristic using interdigitated microelectrode based sensors for industrial applications

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Highlights

1) Interdigitated microelectrodes biosensors were employed to analyze the temperature and pH shift in impedance measurements.
2) A novel impedance mathematical model was developed and validated.
3) The influence of different parameters (sensor's design, temperature, pH and frequency of measurements) were evaluated on impedance.
4) Impedance measurements were corrected from temperature and pH effects.

Abstract

Impedance spectroscopy analysis (IS) has awakened a great interest for many industrial applications and sectors for the implementation of novel monitoring capabilities. More specifically, microelectrode-based sensors are increasingly being used to analyze electrical or electrochemical changes in liquid samples, as well as other effects such as biofouling, particle adhesion, etc. However, real environmental conditions are usually subjected physiochemical changes that affect the impedance measurement. In this context, it is difficult to isolate the effect of only one parameter (i.e., conductivity of the medium) from the other ones. This work is focused specifically on the analysis of the influence of temperature and pH on the impedance measurements. Different experiments were carried out using interdigitated microelectrodes (IDE) sensors for a geometry range in wine samples to adjust a proposed mathematical model of the impedance behavior. In the case of fermentation processes of alcoholic beverages, this methodology will help to isolate the chemical changes measured by impedance from temperature or pH variation. This model also provides the significance of the effect of each parameter on the impedance values. After the experimental validation, the model was used to correct the impedance values accordingly to the variation of each parameter showing its applicability to the real field. Finally, the proposed methodology can be easily applied and extended to other environments and sensors types.

Introduction

Impedance sensors allow for measuring electrical and electrochemical changes of different liquid or gas samples and also, adhesion of particles or chemical reactions onto its surface (Barsoukov and Macdonald, 2005; Daniels and Pourmand, 2007). Microelectrode based sensors