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Polymer Membranes on Chemical Semiconductor Devices—Their Electrical Influence on Sensor Characterization

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The electrical influence of polymer membranes on the behavior of semiconductor sensors is investigated. Drastic effects of polymer coating in high-frequency CV-measurements are shown. The problem of analyzing the obtained CV-curves leading to errors in potential determination is discussed. Furthermore, the influence of polymer membranes on the dynamic response of coated ISFETs is characterized. To explain these effects, membranes are studied by means of electrochemical impedance spectroscopy. Cellulose acetate and polyurethane membranes are used as model systems. On the basis of a simplified electrical model, the membrane influence as well as the effect of different electrolytes is discussed, and methods to overcome these effects in CV-measurements are proposed. In addition, a mathematical description of the response behavior of coated ISFETs is given.

1. Introduction

In recent years a considerable number of chemical microsensors have been developed on the basis of ion-sensitive field-effect transistors (ISFET). In order to create sensors of specific sensitivity and selectivity characteristics, combinations of the common field-effect structure with suitable polymeric membranes are often used. For this purpose, both hydrophobic and hydrophilic polymers are applied. The