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Autor: Grasso, F. / Musumeci, F. / Triglia, A.

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DIFFUSE LAYER ELECTRICAL PARAMETERS AT METAL WATER INTERFACE IN THE 0.01 Hz TO 100 KHz RANGE

F. GRASSO", F. MUSUMECI", AND A. TRIGLIA^
"Istituto di Fisica, V.le A. Doria 6, I-95125 Catania,Italy
^Dipartimento di Fisica, C.so Italia 57,I-95129 Catania-Italy

Abstract: The impedance of a water filled cell has been measured in the 0.01 Hz to 100 KHz and in the 5°C to 80°C range. The capacitance and resistance of the diffuse layer is reported.

1. Introduction

To study the behavior of an ideal polarizable liquid-electrode interface can be used a model, proposed by Gouy, Chapman and Stern (GCS) (1) and recently validated (2), which consider the interface as made up of two layers: the Helmoltz layer, and the diffuse charge layer. The behavior of the diffuse charge layer, in opposition to that of the Helmoltz layer, is not well known though it could give some informations on the dielectric properties of the solution at low frequency.

2. Experimental results

The experimental setup here adopted consists of a series RZ circuit, Z being the impedance of the cell containing the liquid and R a load resistor, driven by a sinewave signal. The cell impedance is obtained from the measurements of the signal attenuation and phase shift. The sample water is Analar by BDH. The measure cell filled up of water can be described by five parallel R-C meshes connected in series referring to the two Helmoltz layers, to the two diffuse layers and to the bulk water. In our conditions it is possible, from the measured impedance vs frequency, to obtain the value of capacitance and resi-

stance of each circuit element. The results of the elaboration are shown in Fig. 1a) and 1b) and in Fig. 2a) and 2b), which report respectively the resistance R_d and capacitance C_d of the diffuse charge layer vs signal frequency and vs sample temperature.

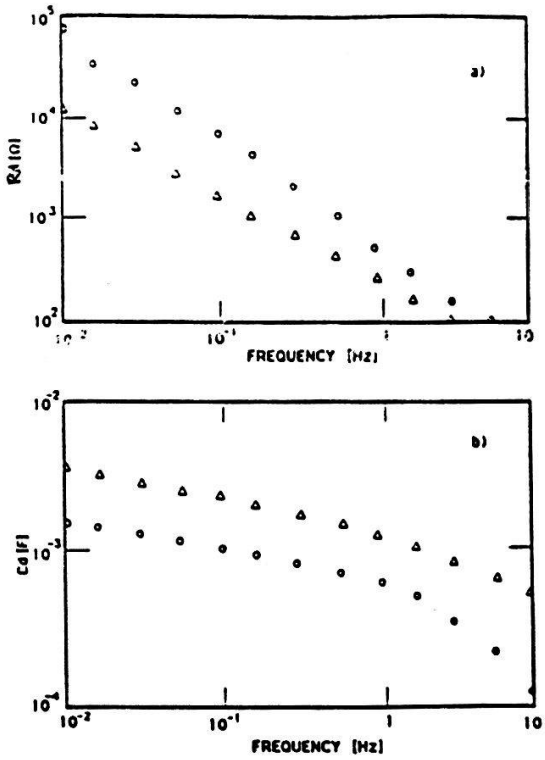

Fig. 1 - Calculated resistance (a) and capacitance (b) of the diffuse layer vs frequency at two temperatures: 5 °C (o) and 80°C (Δ).

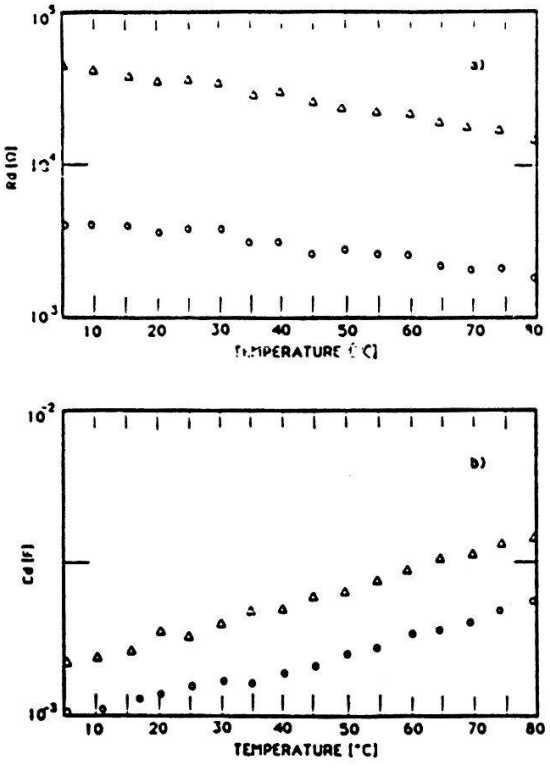

Fig. 2 - Calculated resistance (a) and capacitance (b) of the diffuse layer vs temperature at two frequencies: 0.01 Hz (Δ) and 0.1 Hz (o).

The results do not agree with the CGS theory, though the experimental conditions are within its validity range. So it is necessary to postulate an anomalous dependence of water dielectric constant and of the ion number near interface from both signal frequency and sample temperature. We are carrying out further studies to go deep into this question.

4. REFERENCES

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2) A.A. Kornyshev et al, Phys.Rev. 25, 5244 (1982).