A New Approach of Transmission Vop-Spectroellipsometry for Studying Electrochemistry and Solution chemistry

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Introduction:

Up to now, it is still very difficult to find an in-situ technique through detecting the properties of solution to study a reaction in electrochemistry, solution chemistry, or other liquid system. On the basis of experimental results for studying electrochemistry with the Vop-Spectroellipsometry, the authors found that the polarized light passing through the solution can get some information about the concentration of solution from the optical parameter Δ, Ψ measured. It means one could find the concentration and its changes from the Δ, Ψ and its changes measured through ellipsometry.

Experimental

The polarized light from a Rudolph 2OOOFT Ellipsometer with the wavelength 546.1nm was passing through a rectangle quartz cell filled with the solution of fixed concentration of $NiSO_4$, and we got the Δ, Ψ data of the solution automatically.

Since the Δ, Ψ measured are related to the different materials of cell, the different solution, the size of light spot, experimental temperature, the thickness of liquid layer and so on, we need fix all the experimental condition during a same series of experimental process.

Results and discussion:

Table 1 lists the measured Δ and Ψ for a set sample of the pure water and $NiSO_4$ solution with different concentrations.

Table 1. Measured Δ, Ψ for H_2O and $NiSO_4$ solution

	H_2O	Concentration of $NiSO_4$ Solution/mol/L					
		1×10^{-3}	1×10^{-2}	5×10^{-2}	1×10^{-1}	5×10^{-1}	1.0
Δ/deg	60.00	60.07	60.31	61.22	62.23	63.36	63.71
Ψ/deg	47.78	47.76	47.82	47.85	47.91	48.11	48.12

For determining an accurate data of Δ or Ψ of a fixed solution, we have measured over twenty times and have the average value listed in the table 1. The relative average deviation are$<\pm0.15\%$.

The data listed shows that the solution with fixed concentration has a fixed Δ and Ψ, it means that we could get the concentration of an unknown solution by the Δ and Ψ measured from ellipsometry. It also means that the changes of the Δ, Ψ can be use to realize the changes of the concentration of the solution tested.

The polarized light passing through the different layer with different distances from the electrode surface, one could get the changes of different Δ、 Ψ, it also get the information of the changes of concentration. We could use this idea to study the mass transfer process in the solution related to an electrode process. In fact, we have done that experiment and published last year.

This new approach also could be use to study solution chemistry because any reaction will related to the mass transfer in solution.

References

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