ELECTRODES FOR ELECTROCHROMIC DEVICES STUDIED BY EQCM

P. Špičák[1], V. Svoboda[1], M. Sedlaříková[1], J. Vondrák[2], J. Kazelle[1]

[1] Institute of Electrotechnology, Technical University of Brno, 602 00 Brno
[2] Institute of Inorganic Chemistry AS CR, 250 68 Řež near Prague

Introduction

The mass of thin layer electrodes can be observed by the QCB method; it is based on the changes of resonance frequency of a quartz crystal resonator. The investigated substance is deposited on the surface of the resonator. Various metals (Pt, Au, Ag) and their compounds should be plated on the resonator. Most frequently, the resonators for the frequency 5.0 MHz are used.The crystal surface with the layer is exposed to the electrolyte in a three-electrode system, usually driven by a potentiostat. This frequency change is used for detection of chemical changes of the electrode surface. This system is very sensitive.

Experimental

The aim of the work was the initial study of the method called QCB for the investigation of thin layer electrodes suitable for electrochromic devices. Those devices can modulate the intensity of light passing through them by the ibtercalation of various cations into them.

We started with a crystal calibration for define sensitivity of the crystal resonator. The measuring included two basic methods. The cyclic voltammetry and the potentiometry, both methods were realized on an Autolab and the QCB unit PM 710 from Maxtek.

The cyclic voltmetry includes the measuring two and three point's method. For the potentiometry we used two points method. We have used a different fast scan rate.
For the calibration, the electrodeposition of copper from 0,1M Cu $(NO_3)_2$ + 0,2M H_2SO_4 electrolyte and Cu electrodes was used.

The intercalation of cations into vacuum deposited layers of WO_3 .was investigated. Hydrogen ion intercalation was performed from 1 M H_2SO_4, while $LiClO_4$ or $NaClO_4$ (0.1M solutions in propylene carbonate) had to be used.

The layers of WO_3 were vacuum deposited on the crystals. A series of experiments with resonators covered by layers of ITO were done for comparison.

Results and discussion

The calibration of the resonator in Cu salt solution by a chronopotentiometry is shown in following Fig. 1 as an example.Current -0.003 A followed bu +0.003A (both for for 500 s.) were used:

1) Zero current with 200 sec duration
2) -0.003 A with 500 sec duration
3) 0.003 A with 500 sec duration

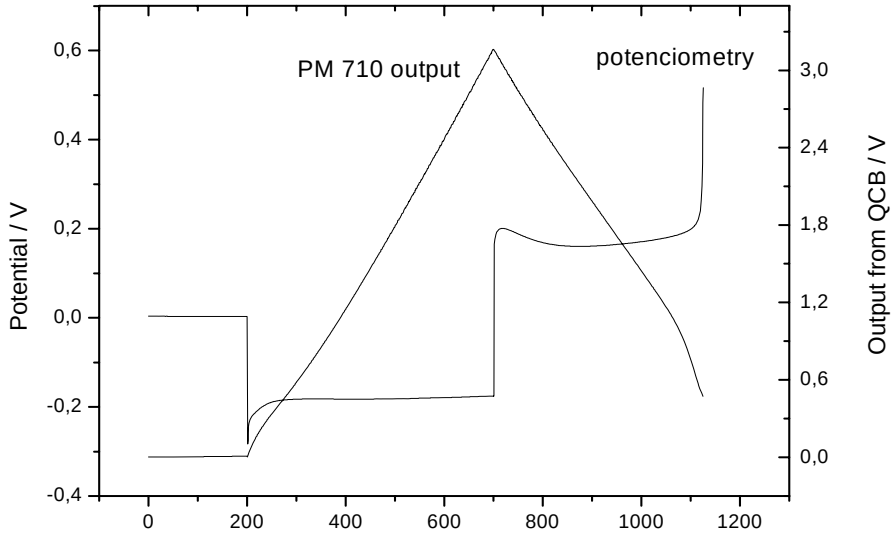

***Fig. 1** Chronopotentiometry, 0.1M $Cu(NO_3)_2$ + 0.2M H_2SO_4*

The behavior of WO_3 in the solution of $LiClO_4$ is given in Fig. 2 as an example.

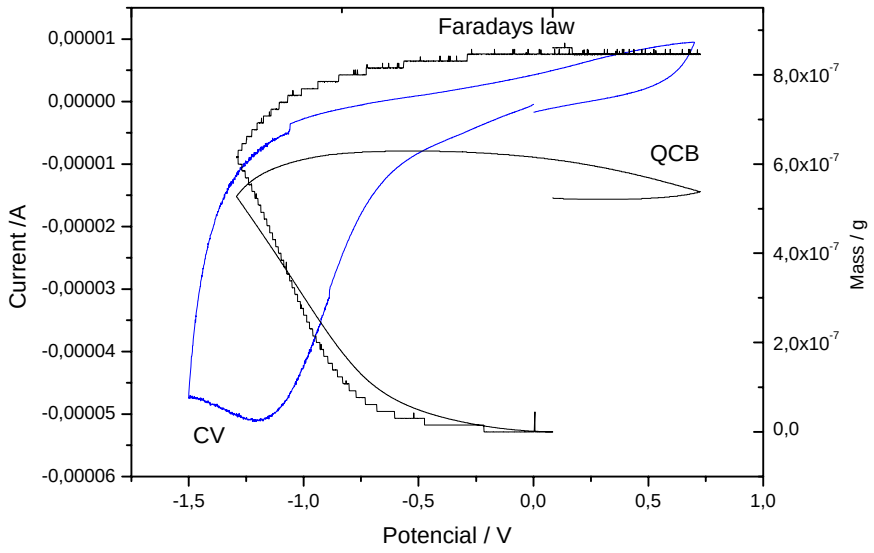

***Fig. 2** Cyclic voltametry, 0.1M $LiClO_4$, The weight changes of Li in WO_3 layers*

Conclusions

The aim of this work was to verify the possibility of application of the QCB method for electrochromic thin layer electrodes. The intercalation of H^+, Li^+ and Na^+ was detected by the method. The question of co-intercalation of the solvent with the ions can be detected easily by this method. The work has indicated the possible continuation of the research in future. The ITO layers have shown a great instability under condition of cation insertion.

Acknowledgements

This work was supported by Grant Agency of Czech Republic (grant NO. MSM0021630516) and Grant Agency of the Academy of Sciences (grant NO. B 208130604) and Minystry of Education (project NO. MSM 0021630516).

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