Application Note

Cobalt Deposition and Dissolution

Summary

Use of AWS A20 Research Platform in combination with a compatible potentiostat to perform an electrochemical study of deposition and dissolution of metallic layers onto the gold electrode of an AWS HFF-QCM sensor.

Introduction

In this Application Note, the AWS A20 Research Platform monitored the phase-shift changes at constant frequency related to the sensor's surface mass changes. The high sensitivity of the HFF-QCM sensors and the high resolution of the AWS A20 RP system allows measuring the very low mass changes associated with a small number of atomic layers deposited.

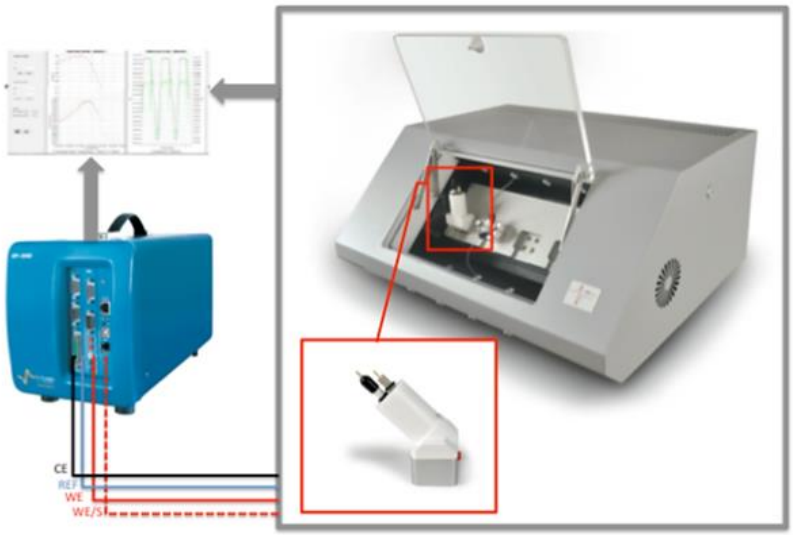
Materials and Methods

Materials. A 100 MHz AWS HFF-QCM sensor was used with a single-channel AWS A20 RP platform in combination with the SP-200 floating Mode Potentiostat/Galvanostat from Biologic.

The signals associated with the sensor phase monitoring in the AWS A20 RP and the current and potential measurement of the SP-200 were monitored. The deposition solution was 10 mM K_2SO_4 + 0.001 M KCl + 0.001 M H_2SO_4 + 0.001 M $(CoSO_4)\cdot 7H_2O$ solution.

A Pt counter electrode was used with a saturated KCl solution Ag/AgCl reference electrode. The working electrode was the grounded electrode of the HFF-QCM sensor.

Cyclic Voltammetry. Determination of the Nernst equilibrium potential and the investigation of the overpotential deposition of Cobalt on the gold electrode of the HFF-QCM. The potential was held at –0.4V ten seconds before starting the cyclic voltammetry.



AppNote | EQCM | AWS A20+ | AWS HFF-QCM

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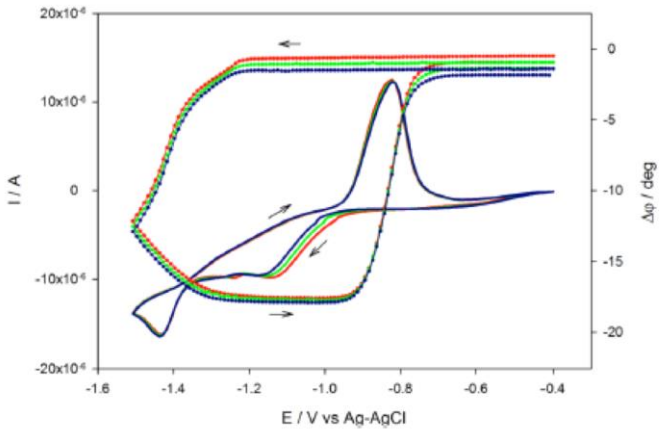
A potential scan with a rate of 10mV/s was applied from –0.4 to –1.5V.

Underpotential Deposition. Controlled deposition of atomic layers of Cobalt on the HFF-QCM.

Results

Figure on the right shows the typical cyclic voltammogram of the overpotential deposition of Cobalt on the high resolution microbalance sensor. Similarly to classical QCM, where frequency shifts occur during bulk deposition, phase-shift changes are found correlated with deposition and dissolution current peaks during the electrochemical experiment.



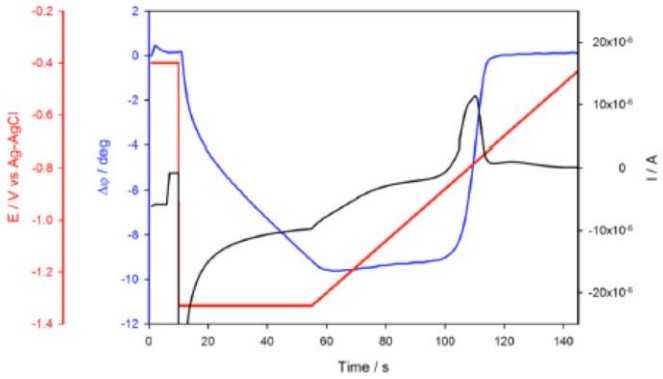


Figure on the left shows the current and phase-shift monitoring when potential step of –1.3V is applied. With this potential step below the Nernst equilibrium potential only few layers of cobalt are deposited on the HFF-QCM gold electrode. The potential is maintained during 30 seconds and a linear potential decrement with a rate of 10mV/s is applied. Phase-shifts show the deposition and dissolution of cobalt during the experiment.

Order Information

Product	Quantity	Reference
AWS A20+ RP -1 channel	1	AWS A20+ 000011 A
HFF-EQCM in-batch cell for AWS A20+	1	AWS CLS+ 000119 Q
AWS HFF-QCM sensor, 100 MHz	1	AWS SNS 000001 A

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