Novel applications of the quartz crystal microbalance technique for the characterization of the solid-liquid interface

A. Bund[1], S.Wehner[1], K. Wondraczek[2], D. Johannsmann[2]
1) Dresden University of Technology, Institute of Physical Chemistry and Electrochemistry
Mommsenstr. 13, D-01062 Dresden, Germany
2) Clausthal University of Technology, Institute of Physical Chemistry
Arnold-Sommerfeld-Str. 4, D-38678 Clausthal-Zellerfeld, Germany

The electrochemical quartz crystal microbalance (EQCM) is a well established technique to monitor small mass changes at the solid liquid interface. However, more information than just the surface mass load can be extracted from EQCM measurements if besides the resonance frequency the damping is monitored (dissipative EQCM) [1].

This paper will discuss some applications of the dissipative EQCM with the main focus on metal depositions and dissolutions. The surface morphology and structure (grain size) of the deposit directly influences the resonance behavior of the quartz. Therefore, the role of additives such as grain refiners and brighteners can be easily studied.

Recently, we showed that by placing a microphone above the oscillating quartz crystal it is possible to "listen" in situ to the shear motion of electroplated layers [2]. It was found that rough layers produce more "noise" (i.e. compressional waves) than smooth layers. Analysis of the hydrodynamics reveals that the frequency of the compressional waves should be double the frequency of the shear motion (Acoustic Second Harmonic Generation, ASHG, Fig. 1). This is in accordance with the experimental results. Possible applications for the screening of electrodeposition processes will be discussed.

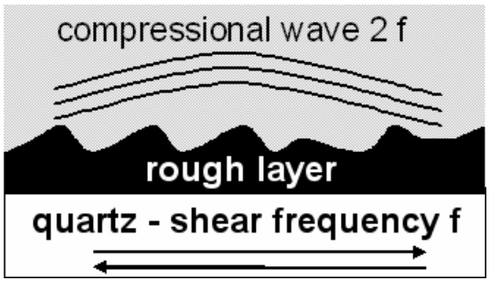

Fig. 1: Schematic representation of the acoustic second harmonic generation above a rough surface.

[1] A. Bund, G. Schwitzgebel; Electrochim. Acta. **45** (2000) 3703-3710.
[2] S. Wehner, K. Wondraczek, D. Johannsmann, A. Bund; Langmuir **20** (2004) 2356-2360.