Characterization of Electromechanical Behavior of an Electrochemical Cantilever System

Quan, Xueling; Heiskanen, Arto; Tenje, Maria; Boisen, Anja

Published in: Proceedings of the 15th International Conference on Electroanalysis

Publication date: 2014


General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Characterization of Electromechanical Behavior of an Electrochemical Cantilever System

Xueling Quan, Arto Heiskanena, Maria Tenje, Anja Boisen*

Department of Micro- and Nanotechnology, Technical University of Denmark, Lyngby, Denmark

This work presents an investigation of the electromechanical behaviour of an electrochemical cantilever (ECC) system, demonstrating simultaneous measurements of the surface stress and surface energy density change at the solid-liquid interface during cyclic voltammetric experiments. The obtained results show that the surface stress response is very sensitive to changes in the solid-liquid interface due to e.g. the concentration of the supporting electrolyte. Different concentrations of redox couples and various potential scan rates were applied to characterize the surface stress change. The direction of the surface stress with respect to the sign of the applied potential was found to be in agreement with the observations reported in literature. For solid electrodes, the two thermodynamic quantities were shown to be significantly different. As shown in figure 1, the change in surface stress of an Au (111)-coated microcantilever was found to vary more strongly than the surface energy density in stable electrolyte and a linear correlation between surface stress and surface charge density was observed. These results are in excellent agreement with previously published findings [1, 2], and demonstrate how acquired cyclic voltammograms enable prediction of the potential-induced surface stress profile between solid-liquid interfaces on micrometer scale. Furthermore, these results indicate that the described ECC system is a suitable tool for characterizing and studying the electromechanical behaviour and surface stress of solid-liquid interfaces.

Figure 1. The simultaneously determined characteristics of an Au (111)-coated electrochemical microcantilever in 200 mM KNO₃: (a) change in surface stress (red dotted curve), surface energy density (open black squares), and charge density (open blue squares) as a function of electrode potential; (b) change in surface stress as a function of charge density change