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Characterization of Electromechanical Behavior of an Electrochemical Cantilever System

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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 an 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.

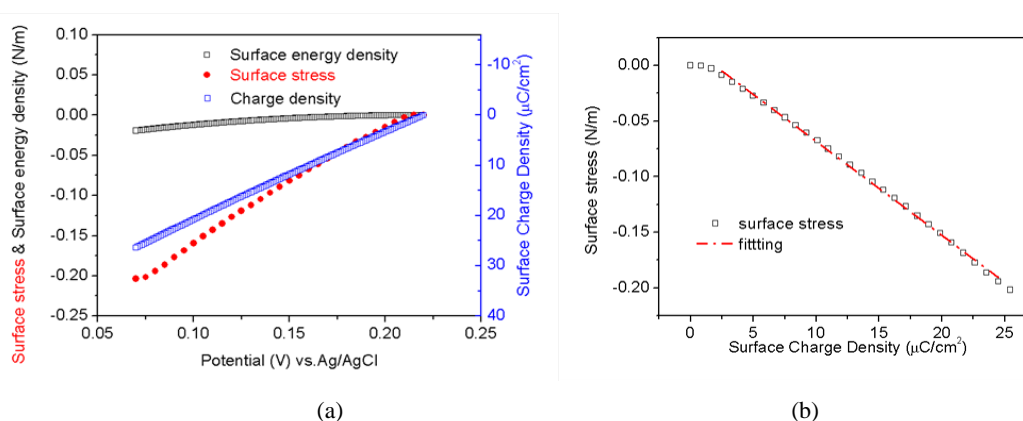


Figure 1. The simultaneously determined characteristics of an Au (111)-coated electrochemical microcantilever in 200 mM KNO_3 : (a) change in surface stress (red dotted curve), surface energy density (open black squares), and charge density (open blue squares) as a function of electrode potential; (b) change in surface stress as a function of charge density change

[1] W. Haiss, et.al., Journal of Electroanalytical Chemistry, 452 (1998) 199-202.

[2] H. Ibach, Electrochimica Acta, 45 (1999) 575-581.