Copper Deposition on the Au(111) electrode influenced by simultaneously adsorbed thymine

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Deposition of copper on Au(111), influenced by several specifically adsorbed anions, is one of the most detailed investigated systems concerning the UPD phenomenon. It is commonly accepted that in case that the point of zero charge of the deposited metal is significantly more negative than the substrate, metal anions stabilize the adatom monolayers.

In our contribution we discuss the influence of adsorbed neutral thymine on the UPD of copper ions. To decrease the influence of specifically adsorbed anions the used electrolyte contains only perchlorate ions as anions.

The UPD involves two steps in agreement with anion stabilized deposition processes.

The kinetics of the formation of the first adatom layer depends strongly on the adsorption state of the physisorbed thymine. If thymine forms a condensed monolayer at the electrode surface the copper deposition is completely inhibited. In contrast, on a surface covered with randomly adsorbed thymine molecules the kinetics of the deposition is similar or more favoured as in the pure perchlorate electrolyte depending on the concentration of thymine molecules.

The formation of the second full monolayer of copper adatoms is generally kinetically favoured in presence of thymine molecules at the surface independently of the adsorption state of thymine. For all experimental conditions the bulk deposition is significantly inhibited. These results raise new questions regarding the UPD mechanism, because thymine under the chosen experimental conditions yields neither a negative charge nor a significant dipole contribution in the planar orientation like specifically adsorbed anions.

We consider the differences in the deposition and the dissolution kinetics, respectively, to get insight into the mechanism of the UPD in presence of neutral organic molecules.