



Assembling Cysteine Monolayers on Low-Index Gold Surfaces

Engelbrekt, Christian; Nazmutdinov, Renat R. ; Yan, J.; Zinkicheva, T.T.; Mao, B.; Ulstrup, Jens; Zhang, Jingdong

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Engelbrekt, C., Nazmutdinov, R. R., Yan, J., Zinkicheva, T. T., Mao, B., Ulstrup, J., & Zhang, J. (2015). *Assembling Cysteine Monolayers on Low-Index Gold Surfaces*. Abstract from The 8th International Workshop on Scanning Electrochemical Microscopy, Xiamen, China.

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.

Assembling Cysteine Monolayers on Low-Index Gold Surfaces

C. Engelbrekt¹, R. R. Nazmutdinov², J. Yan^{1,3}, T. T. Zinkicheva², B. Mao³, J. Ulstrup¹, J. Zhang^{1,*}

¹ Department of Chemistry, Technical University of Denmark, Bldg. 207, 2800 Kgs. Lyngby, Denmark

² Kazan National Research Technological University, Republic of Tatarstan, Russian Federation

³ State Key Laboratory of Physical Chemistry of Solid Surfaces, Xiamen University, Xiamen 361005, Fujian, China

cheng@kemi.dtu.dk, jz@kemi.dtu.dk*

Keywords: cysteine monolayers, gold, scanning tunneling microscopy, voltammetry, DFT

L-Cysteine ($\text{HO}_2\text{CCH}(\text{NH}_2)\text{CH}_2\text{SH}$) is an indispensable amino acid in biology containing a carboxylic acid, an amine and a thiol group. It is also essential as a ligand in stabilization of metalloproteins. Cysteine can assemble on gold surfaces and form stable monolayers due to gold–sulfur bond. Interestingly, surface structures of cysteine monolayers on Au(111) in aqueous solution are drastically different from monolayers formed in ultrahigh vacuum.

In this work we have studied monolayers of cysteine on the three low-index gold substrates in aqueous solution. In situ scanning tunneling microscopy (*in situ* STM) and electrochemistry have been employed to investigate the cysteine monolayers at molecular and submolecular resolution. Highly ordered monolayers have been achieved on low-index gold surfaces Au(111), Au(100) and Au(110). Surface structures such as network like clusters and strips have been disclosed, depending on the structure of the underlying gold substrates. Corresponding coverages of cysteine monolayers have been determined by voltammetry. We have further investigated the dynamics of self-assembled monolayer (SAM) formation of L-cysteine on gold electrodes. The adsorption is monitored by chronopotentiometry at sub-second time-resolution. Molecular packing, geometry and bond energy of the adsorbed molecules, as well as STM contrasts are addressed by molecular modelling based on the density functional theory (DFT) and support the experimental observations.

[1] J. Zhang, Q. Chi, J. U. Nielsen, E. P. Friis, J. E. T. Andersen and J. Ulstrup, *Langmuir*, **16** (2000), 7229-7237.

[2] R. R. Nazmutdinov, J. Zhang, T. T. Zinkicheva, I. R. Manyurov and J. Ulstrup, *Langmuir*, **22** (2006), 7556-7567.

[3] J. Zhang, Q. Chi, R. R. Nazmutdinov, T. Zinkicheva and I. Manyurov, *Langmuir*, **25** (2009), 2232-2240.

[4] C. Engelbrekt, R. R. Nazmutdinov, J. Yan, T. T. Zinkicheva, B. Mao, J. Ulstrup, J. Zhang, manuscript under preparation.