Platinum surface instabilities and their impact in electrochemistry

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Propositions

accompanying the thesis:

"Platinum Surface Instabilities and their Impact in Electrochemistry"

1. When performing measurements, one should always be mindful of the limitations and drawbacks inherent in the instrument or technique used. In the case of operating an Electrochemical Scanning Tunneling Microscope (EC-STM), one of the most important issues is tip convolution, which leads to a tip-shape dependency of the images obtained. (Chapter 2)

2. The origin of step bunching resides in the high repulsive interaction between closely spaced steps, which is lowered by the formation of step bunches with larger separation. Therefore, this instability is intrinsic to any surface with a high step density, regardless of the material. (Chapter 3)

3. Step bunching has a significant impact on the electrocatalysis of stepped platinum surfaces with narrow terraces, and it explains the anomalous step density-dependent trends reported in literature.
(Chapters 3 and 4)

4. The restructuring of platinum surfaces during oxidation-reduction cycling is based on instabilities that result from hindered (ad)atom diffusion.
(Chapter 2 and Outlook)

5. The fundamental principles underlying thermodynamics of surfaces and thermodynamics of electrochemical processes (e.g. electroadsorption) are inherently similar. Consequently, gaining a deep understanding of one naturally facilitates understanding the other.

6. The main goal of physics is to elucidate fundamental laws and build mathematical frameworks that approximate the complexity of natural phenomena. Therefore, by definition, our theories are always imperfect, and it is only a matter of time before a current model is replaced by a more accurate one.

7. Resilience, as well as the ability to remain calm and focused even when problems come up, are essential for success in long, challenging EC-STM measurements.

8. It is definitely worth spending a few months of the Ph.D. acquiring decent programming skills in Python.

9. Producing research articles does not necessarily translate into acquiring new knowledge. Whilst the former is commonly required as proof of a successful Ph.D., the latter is usually the most important in the long run.

10. In an interconnected world where disinformation spreads quickly, divulging science as well as teaching critical thinking to the general public is as important as finding new answers.

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