



Universiteit
Leiden
The Netherlands

Interaction of oxygen and carbon monoxide with Pt(111) at intermediate pressure and temperature : revisiting the fruit fly of surface science

Bashlakov, D.

Citation

Bashlakov, D. (2014, October 14). *Interaction of oxygen and carbon monoxide with Pt(111) at intermediate pressure and temperature : revisiting the fruit fly of surface science*. Retrieved from <https://hdl.handle.net/1887/29023>

Version: Corrected Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/29023>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/29023> holds various files of this Leiden University dissertation

Author: Bashlakov, Dmytro

Title: Interaction of oxygen and carbon monoxide with Pt(111) at intermediate pressure and temperature : revisiting the fruit fly of surface science

Issue Date: 2014-10-14

*Interaction of Oxygen and Carbon Monoxide with
Pt(111) at Intermediate Pressure and Temperature:
Revisiting the Fruit Fly of Surface Science*

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van de Rector Magnificus prof. mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op dinsdag 14 oktober 2014
klokke 11:15 uur

door

Dmytro Bashlakov

geboren te Ossora

in 1980

Promotiecommissie

Promotor: prof. dr. M.T.M. Koper

Co-promotors: dr. A.I. Yanson

dr. L.B.F. Juurlink

Overige leden: dr. I.M.N. Groot

prof. dr. B.E. Nieuwenhuys

prof. dr. J. Brouwer

prof. dr. B. Dam (TU Delft)

prof. dr. P. Rudolf (Rijksuniversiteit Groningen)

Contents

Chapter 1 Introduction and literature overview	5
1.1. Introduction.....	6
1.2. Catalysis.....	7
1.3. Surface science approach.....	9
1.3.1. Oxygen interaction with Pt(111).....	12
1.3.2. Carbon monoxide interaction with Pt(111).....	13
1.3.3. CO oxidation on Pt(111).....	14
Chapter 2 Experimental instruments and techniques	21
2.1. Omicron system.....	22
2.1.1. Vacuum system.....	22
2.1.2. Auger electron spectroscopy.....	23
2.1.3. Low energy electron diffraction.....	24
2.1.4. Scanning tunneling microscopy.....	26
2.1.5. Sample preparation.....	30
2.2. Lionfish.....	32
2.2.1. Vacuum system.....	32
2.2.2. Temperature programmed technique.....	32
2.2.3. Sample preparation.....	33
Chapter 3 Subsurface oxygen on Pt(111)	37
3.1. Introduction.....	38
3.2. Experimental section.....	39
3.3. Results and discussion.....	40
3.3.1. Oxygen adsorption at various temperatures.....	40
3.3.2. Surface structure.....	44
3.3.3. Oxygen reactivity towards CO oxidation.....	46
3.3.4. $^{16}\text{O}/^{18}\text{O}$ isotope exchange.....	48
3.4. Conclusions.....	49

Chapter 4 Carbon monoxide oxidation on the Pt(111) surface at room temperature: STM and LEED studies.....	53
4.1. Introduction.....	54
4.2. Experimental section.....	55
4.3. Results and discussion.....	58
4.3.1. STM and LEED.....	58
4.3.2. Mass spectrometry.....	65
4.3.3. Effect of CO poisoning on oxygen adsorption.....	67
4.4. Conclusions.....	69
Chapter 5 Correlating surface activity and STM current transients during CO oxidation on Pt(111).....	73
5.1. Introduction.....	74
5.2. Measurement approach and technique.....	75
5.3. Experiment and Results.....	77
5.4. Discussion.....	84
5.5. Summary.....	85
Summary.....	89
Samenvatting.....	91
Curriculum Vitae.....	94