The 21 Century COE Project

Exploring New Science by Bridging Particle-Matter Hierarchy

Short-term Foreign Researchers

Research Report

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Affiliation: Institite of Physics, Poznan University of Technology

Host Researcher in Tohoku University: Prof. Dr. Shozo Suto

Your Stay Period in Japan: From 2004.02.04 to 2004.02.21

Title of Research in Japan:

Experimental data analysis of the STM/STS investigations of the Ag clusters growth on H-Si(111) 1x1 substrate

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Please write a research report of one or more pages and submit it with this cover to your host researcher till the end of this March.

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During my short-term research stay at Prof. Dr. S. Suto Lab I was concentrated on the experimental data analysis of our previous STM/STS investigations of the initial and late growth stages of Ag clusters deposited on H-Si(111) 1x1 substrate. The main point was put on grain analysis that means finding the way of statistical analysis of the grain dimensions and number per area unit as a function of an exposure (quantity proportional to the deposition time and rate) and deposition temperature. I have tried to use different software for the grain analysis and finally I found that the SPIP (Scanning Probe Image Processor) is the most suitable for this analysis. I have elaborated the optimum procedure for the grain data analysis, which gives the most reliable results.

Please find in attachment some examples of the STM images showing the evolution of Ag clusters growth with the increasing exposure, as well as some examples of the grain analysis including files of the Ag clusters dimensions and other useful for this analysis data.

During my short stay it was not possible to analyze all the data we have gathered during previous year. However, I do hope that we have found the way to analyze these data in much more precise and quantitative way.

I have also performed some experimental activities. Together with Dr. A. Wawro, we were investigating the optimal procedure for the Pt/Ir STM tips' preparation by a chemical etching method and subsequent testing the tips by SEM (scanning electron microscope). We have also performed preliminary STM investigations of Pt clusters deposited in Bi_2Te_3 substrate. The Bi_2Te_3 substrate is an interesting narrow gap semiconductor which can be used as thermo-power generator in the nano-scale devices.

I do appreciate Prof. Dr. Suto for the invitation and I do hope that my modest contribution will help to prepare a better output of our experimental data. I also hope to continue our co-operation in near future.

With my kind regards Ryszard Czajka

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08 March 2004

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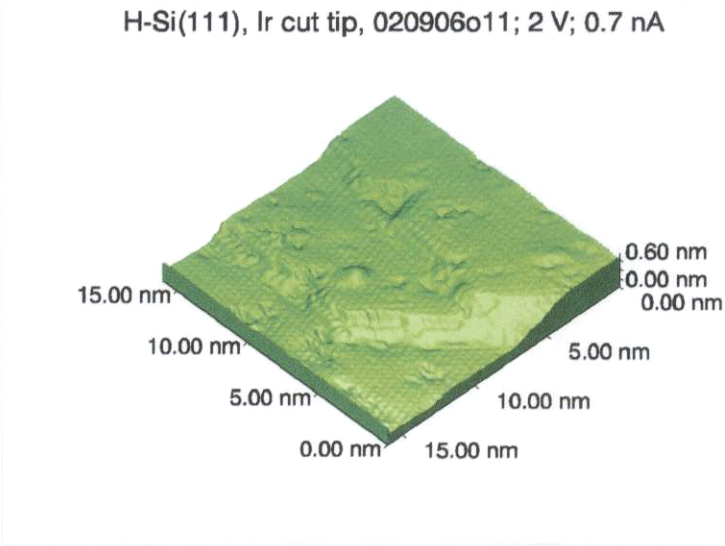
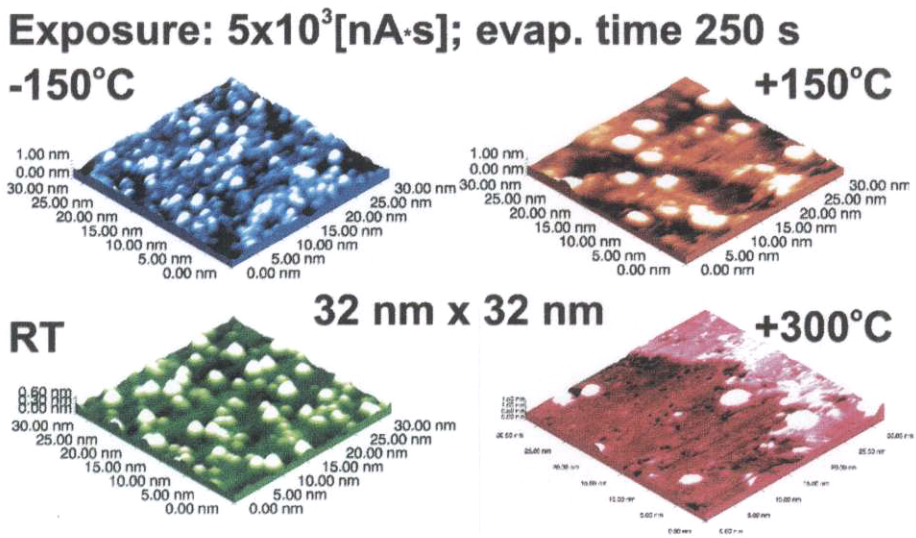
Representative examples of performed data analysis:

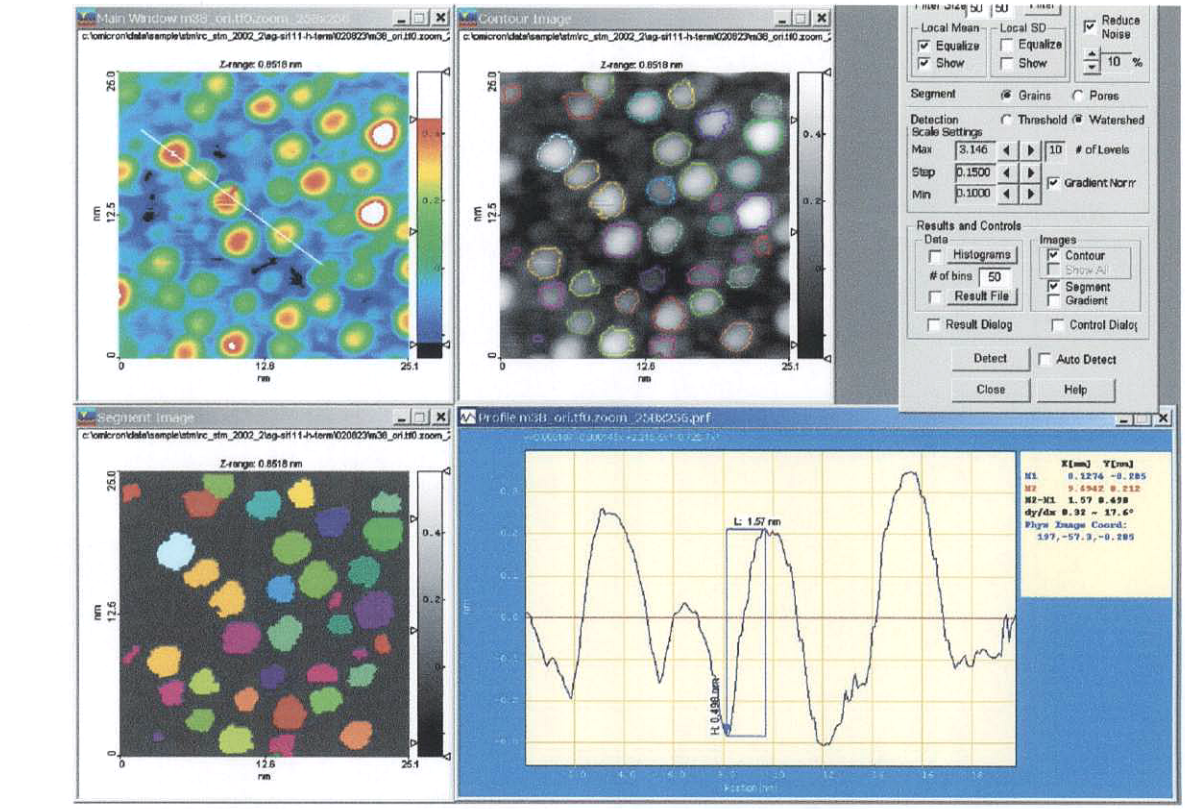
1. Atomic reolution STM image of the H terminated Si(111) 1x1 surface

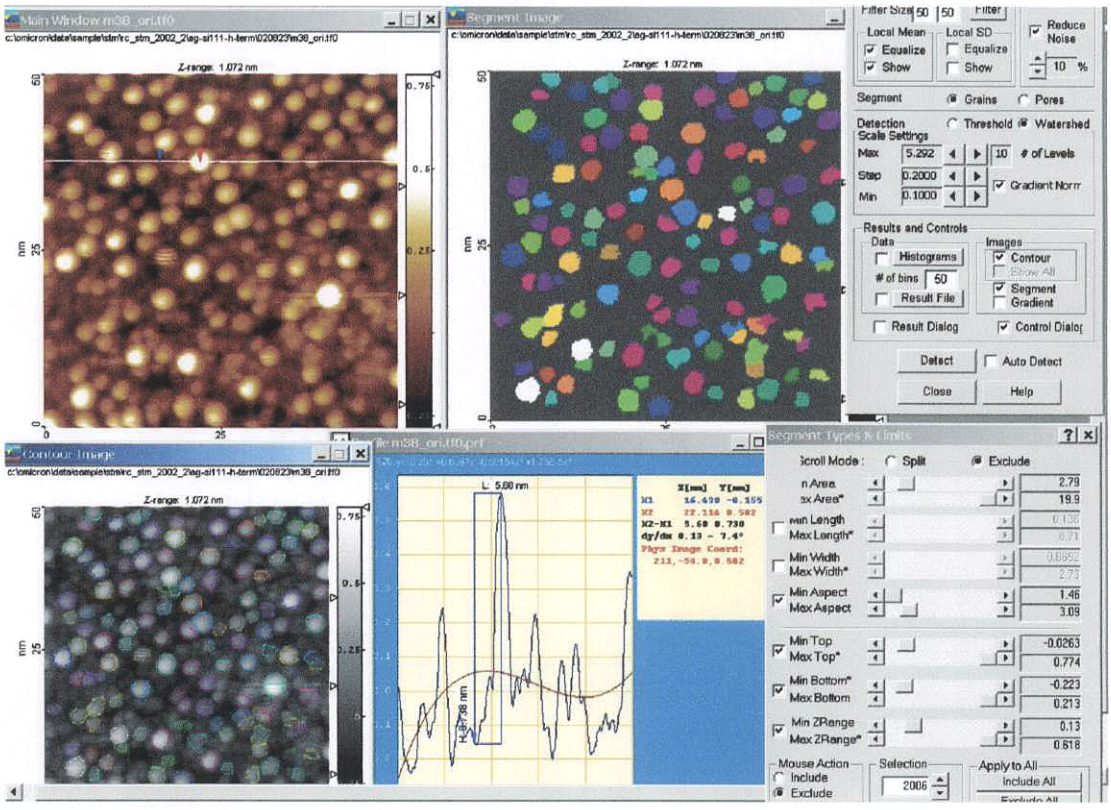


2. STM image of Ag clusters on H-Si(111) 1x1 surface



3. Some examples of grain analysis:





4. Files with the statistical data for detailed grain analysis:

Grain Distribution Analysis Calculated by SPIP V3.1.1.0
Date: 2004 02 18 20:22
File: c:\omicron\data\sample\stm\rc_stm_2002_2\ag-si111-h-term\020823\m38_ori.tf0.zoom_258x256
Detected Grains: 38
Mean Area: 4.54 nm^2
Grains per um^2: 60564
Coverage : 27
%
XRange: 25.1
nm
YRange: 25.0
nm

# ID	Area	Length	Width	Size	Perim	Aspect	Diam	MaxZ	MeanZ	Volume
22	4,4	3,01	1,46	2,94	10,4	2,06	2,37	0,28	0,169	0,745
33	4,25	2,73	1,56	2,54	10,6	1,75	2,33	0,307	0,175	0,744
42	1,74	2,02	0,864	1,57	6,85	2,34	1,49	0,188	0,129	0,225
48	5,89	3,63	1,62	3,62	13,1	2,23	2,74	0,231	0,102	0,619
50	5,84	3,32	1,76	3,13	12,7	1,89	2,73	0,377	0,227	1,33
52	3,71	2,76	1,34	2,64	9,78	2,05	2,17	0,269	0,156	0,578
70	5,44	3,21	1,69	3,03	11,7	1,89	2,63	0,381	0,254	1,38
83	8,21	3,62	2,27	3,52	13,9	1,6	3,23	0,552	0,359	2,95
106	7,09	3,51	2,02	3,42	14,1	1,73	3,01	0,368	0,161	1,15
108	7,87	3,61	2,18	3,42	14,3	1,66	3,17	0,444	0,269	2,12
139	5,63	3,03	1,85	2,84	12,5	1,64	2,68	0,337	0,213	1,2
143	5,44	3,42	1,59	3,13	12,1	2,15	2,63	0,279	0,149	0,836
146	7,72	3,46	2,23	3,42	14,1	1,55	3,13	0,424	0,262	2,02
156	4,52	2,76	1,64	2,54	11,4	1,68	2,4	0,144	0,0673	0,332
164	6,73	3,46	1,95	3,23	15,1	1,78	2,93	0,439	0,248	1,67
182	1,12	1,82	0,615	1,57	5,87	2,96	1,19	0,107	0,0597	0,0686
183	8,16	3,75	2,18	3,42	13,9	1,72	3,22	0,579	0,377	3,07
220	6,63	3,39	1,96	3,13	13,5	1,73	2,91	0,339	0,185	1,23
223	2,88	2,28	1,26	2,15	7,83	1,81	1,92	0,18	0,103	0,299
231	7,59	3,62	2,1	3,42	13,9	1,73	3,11	0,439	0,245	1,86
252	1,73	1,8	0,965	1,66	7,24	1,86	1,49	0,0813	0,0366	0,0835
266	1,09	2,02	0,541	1,57	6,46	3,73	1,18	-0,0474	-0,0704	0,0769
269	6,38	3,19	2	2,94	12,1	1,6	2,85	0,342	0,141	0,909
273	0,89	1,48	0,601	1,47	5,09	2,46	1,06	0,0998	0,0579	0,0581
303	3,51	2,82	1,24	2,74	9,39	2,27	2,12	0,142	0,0588	0,251
304	3,86	3,16	1,22	2,94	10,6	2,59	2,22	0,236	0,0975	0,397
306	3,06	2,33	1,31	2,15	8,61	1,78	1,98	-0,0161	-0,0806	0,247
310	4,14	2,67	1,55	2,64	9,98	1,72	2,29	0,19	0,0949	0,411
319	3,52	2,51	1,41	2,35	9,98	1,78	2,12	0,206	0,118	0,42
330	3,26	2,33	1,4	2,15	8,81	1,67	2,04	0,168	0,0724	0,263
331	4,86	2,98	1,63	2,94	11,4	1,82	2,49	0,304	0,176	0,86
342	6,58	3,18	2,07	3,03	13,9	1,53	2,89	0,394	0,211	1,4
358	3,71	2,61	1,42	2,54	9,39	1,83	2,17	0,219	0,134	0,496
372	5,21	3,07	1,7	2,94	11,5	1,81	2,58	0,274	0,161	0,84
375	5,87	3,21	1,83	3,13	12,3	1,75	2,73	0,456	0,285	1,67
393	0,412	0,923	0,446	0,783	2,74	2,07	0,724	-0,0427	-0,0561	0,0231
396	3,31	2,63	1,26	2,35	9,59	2,1	2,05	0,207	0,124	0,417
422	0,278	0,902	0,308	0,881	2,54	2,93	0,595	0,148	0,0612	0,0189
Mean	**4,54**	**2,8**	**1,5**	**2,63**	**10,5**	**1,98**	**2,3**	**0,264**	**0,146**	**0,876**
SD	**2,26**	**0,733**	**0,524**	**0,738**	**3,19**	**0,454**	**0,697**	**0,151**	**0,104**	**0,784**

Poznan, 2004.03.08. Ryszard Czajka