SEVENTH SALVE WORKSHOP 2017

REPORT

The 7th SALVE Summer-Workshop was organized by Prof. Ute Kaiser (Ulm University) and, as previous workshops, held in Hirschegg (Austria) in the Alps, from June 19 to 21, 2017. In contrast to the other SALVE-Workshops, this year only the members of the Sub-Ångstrøm Low-Voltage Electron Microscopy (SALVE) Project Team of Ulm University (22 participants) met. The intension was to discuss in more detail the application-related results of one year work on the SALVE machine as well as implement teaching lectures related to the instrument and the imaging process. The program of the workshop included an opening presentation and 11 lectures on various aspects of SALVE applications and 3 lectures with teaching character on the contrast transfer in the SALVE instrument, on the basics of the Cs and Cc/Cs correctors, and on non-linear imaging in the TEM. And as usual a mini workshop was held on Tuesday afternoon. In the after dinner talk on Tuesday, Ute Kaiser reported on her recent conference travel to the Nature Conference in Hangzhou entitled: The next 10 years of TEM and Harald Rose reported his stay in Japan and the prestige distinction he received from the Japanese Electron Microscopy Society in Sapporo.

Opening lecture
The meeting started as usual with the opening presentation from Ute Kaiser about the current state of the SALVE project. She pointed to the tasks to be solved before the SALVE microscope will be moving from Heidelberg to Ulm University in September 2017. And the SALVE team needs to go now steps further in understanding physical properties of the low-dimensional materials under investigation. Johannes Biskupek continued about the state of the art of our SALVE building
and reported that so far all is in the time line for the move in September.

Teaching lectures
In the teaching part, Felix Börrnert gave a general overview on the function of a Cs and of a Cc/Cs corrector as well as about the contrast transfer at 80 and 20 kV in the SALVE TEM in a very comprehensive lecture. Harald Rose tought nonlinar imaging, the term refers to linear and non-linear behavior in the scattering amplitude.

Lectures in spectroscopy
In the spectroscopy and EFTEM sessions, Michael Kinyanjui introduced the basics of momentum-resolved EELS and gave a number of examples showing the rich physics, one can obtain when compared to calculations. Michael Mohn presented his paper on momentum-resolved EELS applied to heterostructure in its very final form. Johannes Biskupek presented results on EFTEM on Si and C, the C image showed for the first time an inelastic signal in the EFTEM image.

Lectures in imaging
In the imaging session, first a new method for determination of electron source brightness and illumination semi-angle distribution was presented by Julian Renner, a very practical method, which brings light in the so far inconsistent discussed values and is important to know for image calculations. Again the important topic of radiation damage understanding was discussed by Tibor Lehnert and he suggested a two step damage mechanism, which needs to be confirmed further. The matter of cleaniness of the sample is important and Tibor Lehnert and Christel Dieker spent already a lot of work finding out most possible clean working conditions in our new SALVE building. In her talk on differential phase contrast, Zhongbo Lee presented her recent calculations on STEM phase contrast, a method, which points to future developments in TEM.

In summary
Our 2017 year's workshop focused on in-depth discussion of all our SALVE-project related questions, which are: (1) The state of the new SALVE building which should be finished in September 2017 and the organisation of the move of the SALVE instrument from Heidelberg to Ulm; (2) Understanding the basics of Cs and Cc/Cs correction as well as the discussion about the contrast transfer in particular at 20 kV, (3) Understanding of the potential and the current limitations of EFTEM and momentum-resolved EELS in the SALVE instrument; (3) Advancing the theory of phase contrast in TEM and STEM and non-linear imaging and finally: (4) Reports on the application of imaging and spectroscopy in the SALVE instrument (performed at our machine located in Heidelberg) about atomic defects and atomic interactions in 2D inorganic and organic materials and single walled carbon nanotubes. This group discussion meeting is regarded also as preparation of the final SALVE celebration, which will be held in December 2017.

WORKSHOP PROGRAM

Monday, June 19

15:00 - 15:30 Welcome and State of the SALVE Project and Current Chal lenges
- U. A. Kaiser

15:30 - 16:00 State of the SALVE building
- J. Biskupek

16:00 - 17:00 (1) Basics of the Cs and Cc/Cs corrector
(2) Contrast transfer in the SALVE at 80 and 20kV
- F. Börrnert

17:30 - 18:00 HR-EFTEM: Current possibilities and limitations, future pro ject
- J. Biskupek

18:00 - 18:30 Momentum-resolved EELS on layered materials
- M. Kinyanjui

20:00 - 20:30 Momentum-resolved EELS on 2D hetero-structures
- M. Mohn

20:30 - 21:00 Situation with our current sample, challenges and priorities
- all

Tuesday, June 20

8:30 - 9:15 Non-Linear Imaging
- H. H. Rose

9:15 - 9:45 Phase contrast in TEM and STEM
- Z. Lee

9:45 - 10:30 What we can learn from the interaction of Me-atoms in CNTs
- K. Cao

10:30 - 11:00 Vitrified TMV for SALVE microscopy
- W. Tichelaar

11:30 - 18:30 Miniworkshops

20:00 - 21:00 Recent Conference Reports: Harald Rose and Ute Kaiser

Wednesday, June 21

9:00 - 9:30 Towards understanding radiation damage in $MoSe_2$, MoS_2, WS_2
- T. Lehnert

9:30 - 10:00 A new method for determination of electron source bright ness and illumination semi-angle distribution
- J. Renner

10:00 - 10:30 TEM on 2D polymer crystals
- H. Qi

10:30 - 11:00 Summary
- U. A. Kaiser

Our 2017 year's workshop focused on the state of the new SALVE building and the move of the SALVE instrument from Heidelberg to Ulm as well as application of imaging and spectroscopy in the SALVE instrument performed in Heidelberg and new theoretical and experimental results in general. We look foreward to the final SALVE celebration, which will be held in December 2017.

Group photo of the 7th SALVE Workshop in Hirschegg, Kleinwalsertal

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Ministry for Science, Research
and the arts Baden-Württemberg

WORKSHOP participants

Participants	Institutions
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