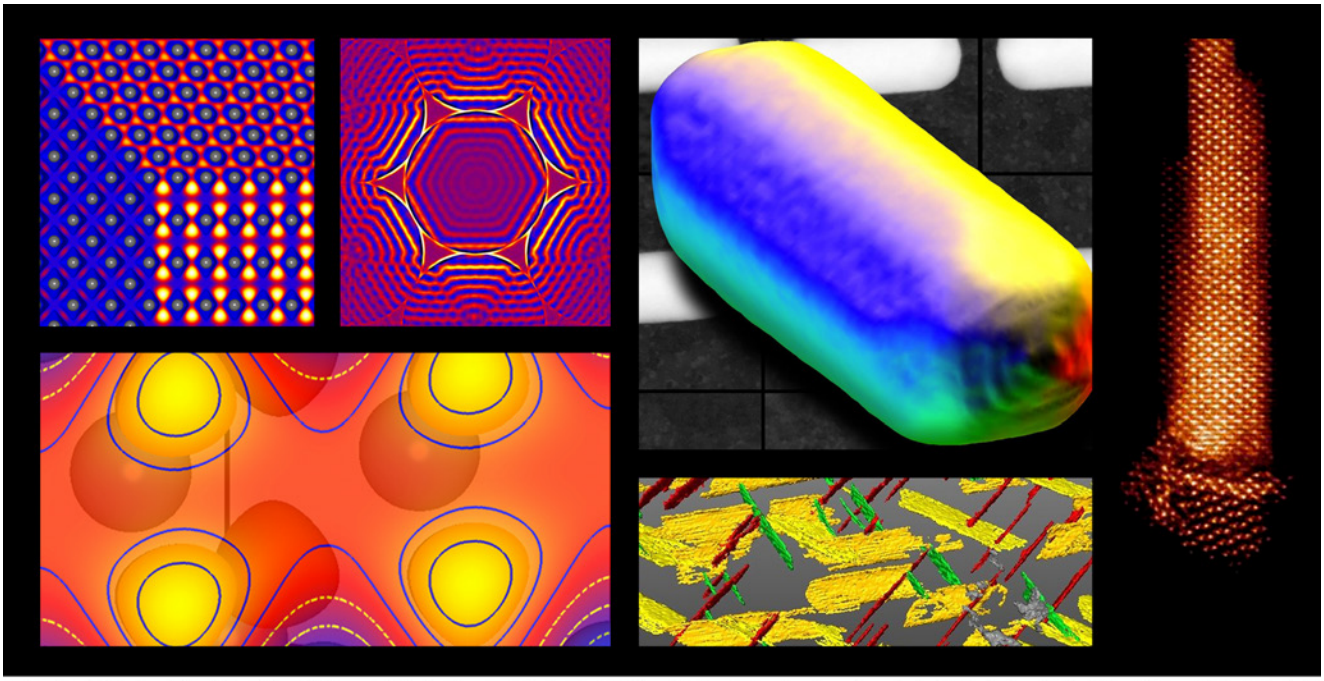

FEMMS 2013 Conference in Lorne, Australia

14th FEMMS 2013: Latest Techniques and Applications

Ute A. Kaiser at the Frontiers of Electron Microscopy in Materials Science (FEMMS) conference 2013, Australia

September, 8th-13th 2013 - At the "Frontiers of Electron Microscopy in Materials Science" in the Convention Centre in Lorne, Australia Prof. Ute A. Kaiser was invited to report on the latest results of the SALVE project. The meeting is focus on the latest in techniques and applications and aimed at fostering high level collaboration and discussion amongst established researchers, instrument manufacturers, postdocs and students. Kaiser's talk in the topic "Emerging techniques in Electron Microscopy" on September 12th 2013 was entitled "New strategies for the analysis of materials at low accelerating voltages".

The Topics of the conference were:

— Modelling and Simulation in Microscopy
— Spectroscopy
— Electron Diffraction and Holography
— Techniques for 3D/4D Analysis
— In-situ Electron Microscopy
— Materials Applications
— Emerging techniques in Electron Microscopy
— Development of Instrumentation and Technique

Conference abstract: FEMMS 2013 by Ute Kaiser

Recent developments in aberration correction [1,2] allowed low-voltage electron microscopy; addressing electron energies down to 40keV [3], 30keV [4], and 20keV [5] because many materials, in particular low-Z materials, often require imaging at energies appreciably lower than 80keV or 60keV as they are destroyed at higher voltages. To obtain images with high contrast and high resolution at these low energies, it is mandatory to compensate for the spherical and chromatic aberration of the objective lens [6]. However, although the correction of spherical and chromatic aberrations of optical lenses in the TEM has now been achieved, a new fundamental physical limitation has been found: stochastic image spread resulting from thermal magnetic field noise [7]. As a consequence of this disturbance, contrast and resolution decrease. For the very first time, this new contrast envelope has been considered in revised corrector designs for the SALVE project. We demonstrate the current state of contrast and resolution of the SALVE microscope with the first SALVE corrector via imaging of graphene.

We show the feasibility of a new approach by calculations of the image contrast as function of the electron dose and sampling rate. Moreover, we show by means of image calculations [8, 9] that in the case of spherical and chromatic correction, the image contrast cannot be described at 20keV and 40keV by means of the weak phase-object approximation, even not for graphene, a mono-atomic layer of carbon atoms. We show first experimental and simulated energy-filtered elastic and inelastic images of graphene and silicon [9] and TiO2.

Low-dose modes combined with appropriate image processing techniques need to be developed to image the pristine defect state of a material [10, 11]. The use of CNTs as containers and graphene-sandwiching are effective means for protecting radiation-sensitive mate-

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rials, as will be demonstrated by several experimental results. In the application part we show that fundamental physical questions concerning two-dimensional objects, such as the full life circle of a dislocation [12] and the atomic structure of amorphous phases, can now be answered [13].

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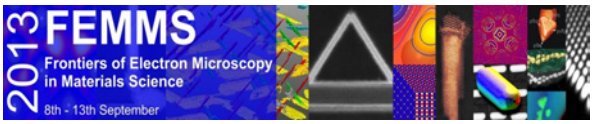

More information: Frontiers of Electron Microscopy in Materials Science (FEMMS), online at: http://www.femms2013.org/