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Aberration corrected ETEM – a tool for *in situ* characterization

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The addition of aberration correction and monochromation to environmental TEM (ETEM) has improved the point resolution and reduced image delocalization allowing for a more direct interpretation of surfaces and interfaces. The development of this unique *in situ* characterization tool has a huge impact on the materials problems, which can be addressed. Below I have listed three (of many) topics, which have benefitted significantly from the use of ETEM.

1. Sintering of Nanoparticles: Sintering is a huge problem within heterogeneous catalysis. The loss of catalytic active surface area during operation by sintering has been a main topic in catalysis research for decades, but still suffer from some controversies. Imaging the sintering process directly as it happens under catalytically realistic conditions allows for fundamental insight in these catalyst-killing processes [1].
2. Light-Induced Reactions: The aberration correction of the objective lens allows for a relative large pole piece gap maintaining the spatial resolution, leaving space for specially designed TEM holders capable of letting visible light onto the sample in the microscope. This way photo induced reactions can be studied *in situ* under gaseous environments [2].
3. Focused Electron Beam Induced Deposition (FEBID): Operating the ETEM in STEM mode allows studying the initial steps of deposition of metals on substrates using a sub-nanometer electron beam to crack precursors. The deposits can be written with a line width of one nanometer *in situ* in the ETEM [3].

The presentation will give an insight in the vast diversion of materials problems, which is addressed using ETEM and complementary techniques at DTU Cen [4].

[1] T. W. Hansen *et al.,* Microsc. Microanal. 18, 684–690, 2012.
[2] F. Cavalca *et al.*, Nanotechnology 23 (2012) 075705.
[3] W. F. van Dorp *et al.,* ACS Nano 6 (2012) 10076.
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Jakob B. Wagner *is the scientific director of Center for Electron Nanoscopy, Professor at Technical University of Denmark. His research interests cover electron microscopy in general and environmental transmission electron microscopy in particular. The materials systems of interest includes: 1) Heterogeneous Catalysts; 2) Semiconductor Nanowires; 3) Nanofabricated devices. He has authored or co-authored more than 60 peer-reviewed journal articles, review papers, and book chapters.*