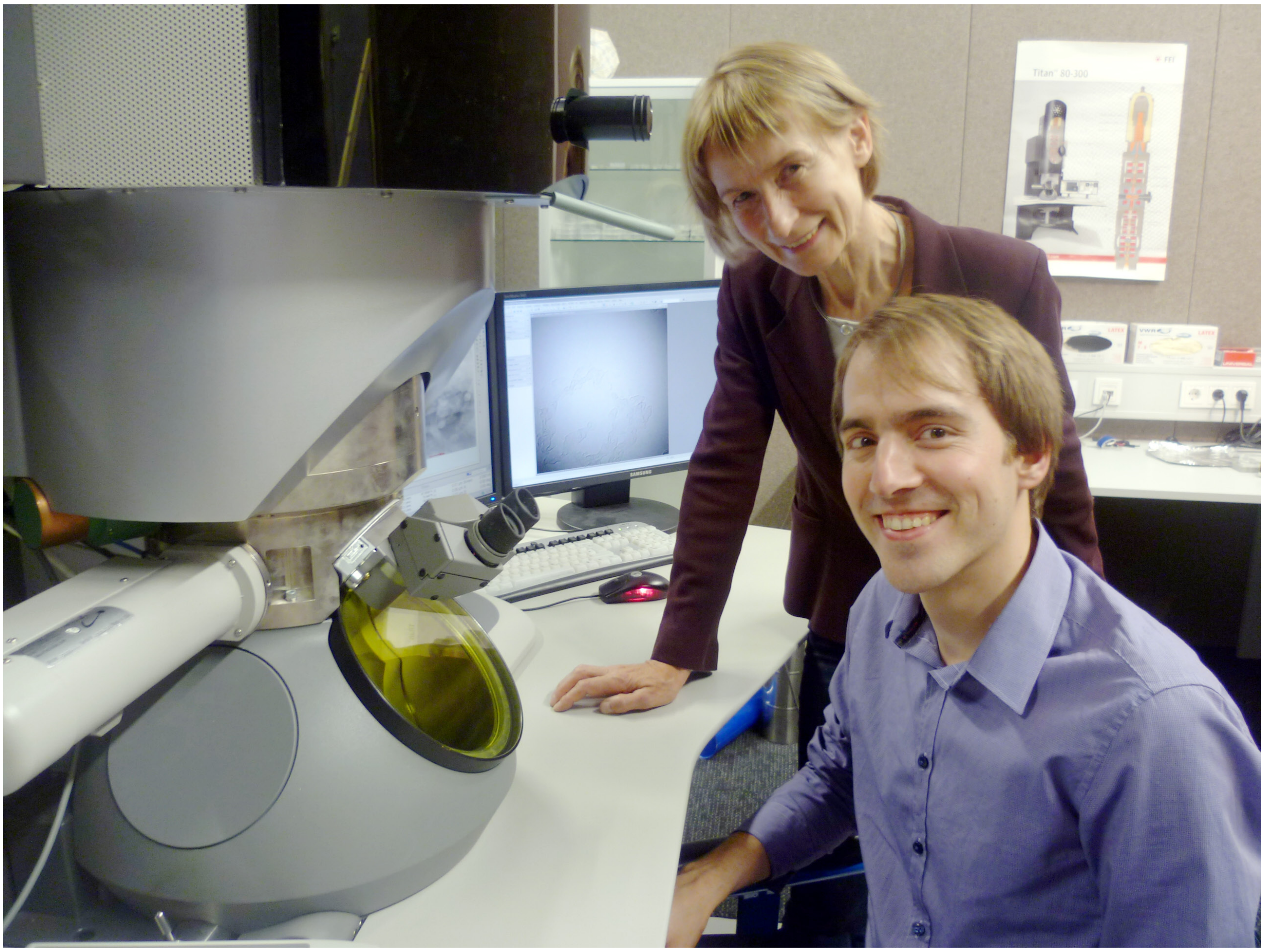

View in the lab with Prof. Ute A. Kaiser and graduate student Simon Kurasch at Ulm University.

# Watching Silica's Dance

Deep watches in the glass on „dancing“ atoms

October 18, 2013 - Ulm/Ithaca - **Physicists at Cornell University (NY) and the University of Ulm managed to visualize for the first time dynamic deformation processes in glass at the atomic level, which go on when glass is deformed, thus bent or melted.**

Everyone held it in his hand and many looked into it probably very deeply: meant is glass. But no one has ever been able to gain so fundamental insights in this particular material as a physicist team of Ulm University and Cornell University (NY) has now achieved. The international research team that together with their colleagues from the Max-Planck Institute in Stuttgart, from the Helsinki and Vienna Universities discovered the world-thinnest layer of glass by a chance finding and that has received an entry in the Guinness Book recently has now succeeded to make deformation processes in such a thin layer of glass visible using transmission electron microscopy. The deformations occur when glass is, for example, bent or melted. These fundamental findings were published today in the latest issue of Science, one of the most prestigious science journals in the world.

The ultra-thin glass layer - it is only one molecular layer thick - was heated by an electron beam. „Here in the transition between solid and liquid phase deformations occur in the atomic structure, which can only be made visible under a special high-resolution electron microscope,“ says Ute Kaiser. The professor of experimental physics directs the group of electron microscopy for materials science at the University of Ulm. Together with the physics professor David Muller, co-director of the Kavli Institute for Nanoscale at Cornell University (NY) and the doctoral students Pinshane Huang (Cornell) and Simon Kurasch (University of Ulm), the researchers were able to make atomic transformations visible that occur before glass breaks. The highest-resolution transmission electron microscope (TEM) of the University of Ulm was used for this study.

The researchers have thus not only provided the experiments showing that glass's silicon and oxygen atoms are arranged quite irregularly in different polygons. „We were even able to film how five-and seven corners glass rings reorganize to hexagons in the melting process“ says Simon Kurasch who performed the experiments as PhD student in Ulm. „You can watch atoms “dancing”, and track the changes of their atomic positions through our evaluation technique specially developed for this study“ explains Pinshane Huang, PhD student of Muller's team at Cornell University. The U.S. physicists have further evaluated the electron micrographs from Ulm. Thereby, the shift of the rotational angles in the transition regions could be made visible and the fluctuation between liquid and solid regions could be quantified.

The insights in the dynamic behavior of glass at the atomic level close a big gap in research. Previously it was only possible to verify assumptions about the basic atomic structure and dynamic properties using computer models or with the help of related colloidal structures. „Now we have for the first time ever actually shown how silicon and oxygen atoms really behave when glass is bent or melted," Ute Kaiser is very pleased to state.


Original Publication:
Huang, P. Y., Kurasch, S., Alden, J. S., Shekhawat, A., Alemi, A. A., Mceuen, P. L., Sethna, J. P., Kaiser, U. A., Muller, D. A. (2013). Imaging Atomic Rearrangements in Two-Dimensional Silica Glass: Watching Silica's Dance. *Science*, 342: 224–227



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