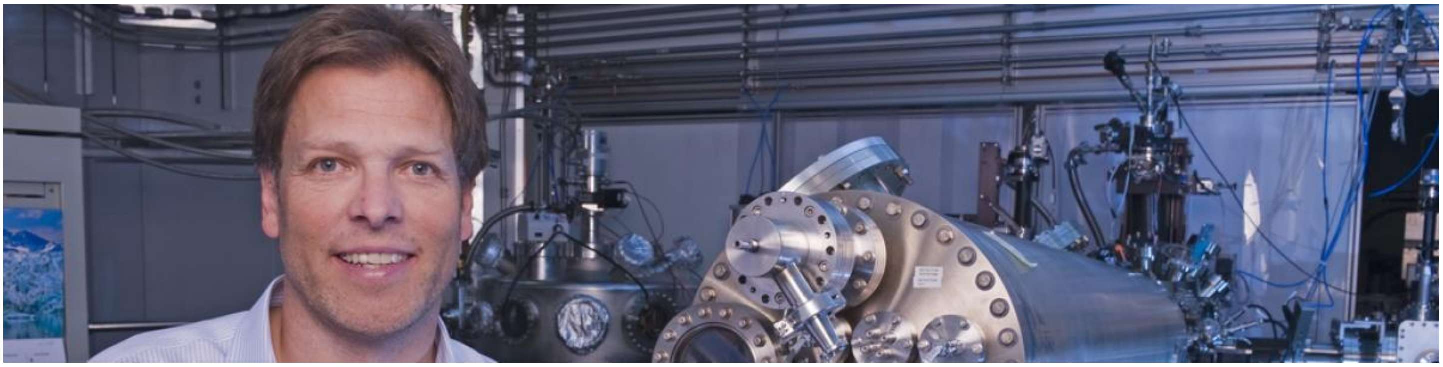
University of Saskatchewan Team Shaping the Future of Technology



Alexander Moewes, Canada Research Chair in Materials Science with Synchrotron Radiation, researching the measurement of the electronic structure of complex materials, magnetic systems and nanostructured materials at the Canadian Light Source

Spotlight On:
Alexander Moewes
University of Saskatchewan
Physics and Engineering Physics

Dr. Alexander Moewes, and his very talented and productive research group, the Beamteam, are studying cutting-edge materials that could shape the future of technology.

“This research is focused on the study of the properties of new materials, specifically the next generation of materials in computers, optoelectronic devices and solid state sensors,” says Dr. Moewes, Professor and Canada Research Chair in Materials Science with Synchrotron Radiation at the University of Saskatchewan.

Professor Moewes and his team compare the measurements from their synchrotron-based spectroscopy to their own calculations in an attempt to predict and tailor the behavior of the outer electrons of novel materials. It is the outer electrons of a material that govern nearly all of its properties - optical, electronic, magnetic, chemical, and even catalytic.

“We have made some recent discoveries on two very different kinds of sample systems,” says Dr. Moewes. “Two dimensional (2-D) systems like Graphene and Silicene, and Spin electronics, often referred to as ‘Spintronics’.”

The group’s research activities have resulted in several recent peer reviewed publications, all based on WestGrid / Compute Canada resources.

“Our calculations are used to determine a number of important quantities in materials and as such we require a large amount of computational resources to undertake these investigations,” said Moewes. “Without WestGrid, these novel materials could not be calculated at all or not in a timely fashion.”

Spintronics, according to a recently published Beamteam paper by Green et al in the Physical Review Letters, could be one way to build more powerful computers. Professor Moewes notes that today’s computing power of exponentially growing storage density and computing speed will reach an end very soon when the transistors in semiconductor chips have become so small that quantum physics prevents any further improvement.

“In spintronic materials the spin and charge of the electrons is used to store digital information,” says Moewes. “The problem is that to date, there is no magnetic semiconductor and spintronics could be the solution.”

The team has been exploring another recently discovered material which could also help contribute to the next generation of computer materials. Silicene, a new 2-D material, may be used to manage quantum effects in computing if researchers can unlock its potential as a semiconductor. A publication this fall by the Johnson et al in Advanced Functional Materials, made an important discovery on what substrates to avoid moving forward.

“We will grow silicene and other elements on different substrates (other than silver) in hoping to create a semiconducting single layer that can be used in new devices,” explains Moewes.

The group has also had a breakthrough with graphene oxide, the world’s first 2-D crystal. This incredibly thin material is as flexible as rubber, conducts better than copper and is 100 times stronger than steel. It has been said that this material is one of the most promising materials being studied in materials science today.

A paper published by Hunt et al in the Journal of Physical Chemistry Letters had the first successful simulation of the Graphene oxide spectra and therefore allows for a better understanding of how the material reacts or “functionalizes” with its environment.

“Our state-of-the-art theoretical calculations are the key when it comes to comparing our measurements and getting more insight into the materials we study. We do have our own much smaller computer cluster, but on these our calculations would take years,” says Dr.

Moewes. “The computing power needed for our research is so large that we could not have done this without Westgrid.”