Transmission Electron Microscopy (TEM) is a key metrology for characterization of atomic structure and composition of wide variety of nanostructures including MBE grown semiconductor structures (e.g. GaN/AlGaN QWs, InAs/ GaAs QDs, and 2D materials), chemically synthesized metal and perovskite nano-particles, SHS synthesized nano-materials, and many others.

Recent developments in TEM have enabled characterization of the structure and composition of nano-materials at the atomic level to establish the relationships between their structure and physical properties. Modern electron microscopes allow observation of individual atoms and can detect a compositional variation in crystals within an atomic column. TEM and STEM imaging at the atomic level, in combination with electron diffraction and composition analysis at atomic and nanometer levels, is available in majority of modern electron microscopes. This provides researchers with unique and powerful "toolkit" to solve complicated materials problems in a fast and efficient manner.

For cross-sectional TEM of hetero-structures, the Focus Ion Beam (FIB) became a routine technique. However, FIB preparation can be a challenging task in case of radiation sensitive materials (such as graphite, CaF2, etc.). To assure a good quality of TEM sample, thin foils prepared by FIB need to be further cleaned (e.g. by low energy plasma) in order to remove the surface damage and contamination. The artifact-free TEM samples are necessary for reliable information on atomic structure and composition. In addition, atomic modelling, HRTEM image processing, and image simulation by commercial software packages are often necessary to support the TEM analysis, especially in case of novel nanomaterials.

Because modern electron microscopes are often fully computer controlled, their operation has become easy for young researchers like graduate students who can get an access to expensive and sophisticated scientific equipment after appropriate training. Therefore, education in the area of electron microscopy materials sciences is an important mission of many electron microscopy centers.
Monday February 19th, 2018

Dr. Peter Müllner, Boise State University
“Magnetic Shape Memory: Terminator 2 - Magnetomechanics - Microfluidics”

You may have seen something like magnetic shape memory (MSM) alloys at the movies. In Terminator 2, a “liquid metal” robot faces off against a more traditionally engineered robot. Although not humanoid, MSM alloy uses the same basic principle: it shape-shifts. Apply a magnetic field, and the material responds with a shape change. Remove the field, and the new shape remains. Apply a different magnetic field and the material re-forms into a new shape. Do this quickly and with purpose and you have a small motor, a micro-pump, or another small device. Invert the concept and you have a power generator or sensor. With such a behavior, MSM alloys could completely alter how we manufacture actuation and sensing devices. Products can be smaller, lighter and quieter since they have no moving parts to wear out. MSM is a new engineering paradigm which requires new engineering approaches to technical tasks. This presentation will (i) introduce the scientific principles including magnetic anisotropy, deformation mechanisms, and magnetomechanics, (ii) outline design principles for MSM devices, and (iii) demonstrate MSM technology at the example of a micropump for drug delivery.

Monday February 26th, 2018

Dr. Marilyn Mackiewicz, Portland State University
“Using Tiny Pieces of Gold to Visualize Stem Cells that Repair Vision Loss”

Cell transplantation is a promising prospective therapy for retinal degenerative diseases and is currently being investigated in multiple clinical trials as a neuroprotective strategy to treat geographic atrophy, the advanced form of dry Age-related Macular Degeneration (AMD). In rodent models of retinal degeneration cell transplantation has been shown to rescue rod and cone photoreceptors, preserve electrophysiological responses of the retina and in visual pathways of the brain, and perhaps most clinically relevant, preserve eyesight. Characterization of cellbased therapies rely on specific information regarding cell survival, migration, and integration in the host that is primarily derived from post-mortem histological assessments. However, the serial nature of this method requires large numbers of animals for these studies at multiple time points since there is currently no method for evaluating efficacious cell-based therapies longitudinally in vivo. Consequently, there is a critical need for the development of technology that would enable us to understand the consequence of transplanting cells into the host retinal tissue as well as visually track transplanted cells survival and
migration in vivo. Without this technology improvement and development of cell-based therapies will continue to be significantly hindered. Here we report the use of hybrid lipid-coated gold nanorods as retinal cell-labeling agents that can also act as contrast agents for in vivo imaging technologies such as optical coherence tomography (OCT). The surface architecture of the gold nanorods can be modified to improve their stability and enhance cellular internalization in retinal pigment cells as visualized by fluorescence confocal microscopy. The approach used to synthesize the hybrid lipid-coated gold nanorods is simple and can be used to produce a library of tailored nanoparticles of varying composition, shape, optical and electronic properties, and surface ligands. When combined with optical imaging technologies, these cell-labeling contrast agents can be used by researchers to assess the distribution, survival, migration, and differentiation of transplanted cells as well as track their location and rate of integration into the host retina in vivo.

**Monday March 5th, 2018**

Dr. Werner Kaminsky, University of Washington
“Great X (-ray) spectations”

Providing X-ray structures to the chemistry department at the University of Washington, Seattle, as well as local businesses, offers the rare opportunity to participate in many different research projects. Our lab also serves other research institutions for the lack of their own facilities. Those small molecule structures we provide have made many publications and especially grant proposals competitive and thus pay for themselves. Although many structures turn out as expected, which in general is not spectacular to say the least, there are occasionally findings that spice up a crystallographer’s life. The presentation will show how submissions of crystals are treated including the basic background needed to understand three example structures: the molecule of a quantum dot, a structure relating malaria medicine to photography, and hop derivatives involved in the science of brewing beer.

**Monday March 12th, 2018**

Dr. Michael Godsey, Concordia University
“Using crystallography to probe the structures of life”

Diffraction of X-rays by crystals allows determination of the electronic structures that make up the molecules in the crystal lattice. X-ray Crystallography of biological molecules follows the same physical rules as
small molecule crystallography, with some complications. Biological macromolecules are large, complex, and commonly display significant flexibility and solvent content. These factors make producing crystals difficult and their diffraction less than ideal. Nevertheless, crystallography is being used in the study of not only known proteins, but unknown and hypothetical proteins as well. The structure of one such hypothetical protein from B. cereus bears a resemblance to the structures of several ADP-ribosylating toxins, so we are using crystallography to probe its potential substrate binding and enzymatic function.

**Wednesday March 14th, 2018**

Dr. Sally Seidel, University of New Mexico
“A New State of Beauty and Charm”

The ATLAS Collaboration at CERN recently announced the observation of a particle with properties consistent with expectations for an excited state of the Bc meson. Mesons are subatomic particles composed of one quark and one antiquark. The Bc meson comprises two heavy quarks: beauty (also known as bottom) and charm. This is the heaviest meson state of two different quark flavors and the first member of the Bc family to be observed above the ground state. The observation provides opportunities for testing predictions based on QCD, the theory of the strong force, and may contribute to extraction of the strong interaction potential.