SEMINAR NOTICE

Department of Physics and Engineering Physics
University of Saskatchewan

SPEAKER: Dr. Alex Moewes
Physics & Engineering Physics

TOPIC*:* ***Direct Measurements of Energy Levels in Next Generation Nitride Phosphors***

DATE: Tuesday March 1st, 2022

TIME: 3:30-4:30 p.m.

PLACE: ***Physics 103***

ABSTRACT:

The outer electrons in matter govern nearly all properties of materials including bonding, structure, magnetism, heat-, electrical- and superconductivity, and optical properties to name a few. Synchrotron radiation allows to access these outer electrons and hence study all of these parameters.

I will give an overview of our group's soft X-ray spectroscopy at the endstation for inelastic scattering at the REIXS beamline at CLS. We use X-ray absorption (XAS), X-ray emission (XES), Resonant inelastic X-ray scattering (RIXS) and X-ray excited optical luminescence (XEOL) to probe the electronic structure of new materials. Our own density functional theory calculations model the measured spectra and allow to extract more detailed information from the systems studied.

The examples I will discuss span a wide range of materials and include low-dimensional materials. I will focus on Eu-doped nitride semiconductors used in lighting applications.

This research presents direct measurements of rare earth energy levels, critical to the color and efficiency of LED phosphors. Modern phosphors use the $5d^1$ to $4f^{n+1}$ transition of Eu^{2+}, which is an excited state since Eu^{2+} has no 5d electrons in the ground state. The 5d states are very sensitive to the surrounding crystal and therefore key Eu^{2+} luminescence parameters like wavelength and efficiency can be tailored by the choice of host lattice.

We are able to experimentally directly determine the energetic separation of the Eu 5d state and the conduction band. We also directly observe conduction to valence band and 4f to valence band transitions in X-ray excited optical luminescence spectra of a series of cutting-edge phosphors.