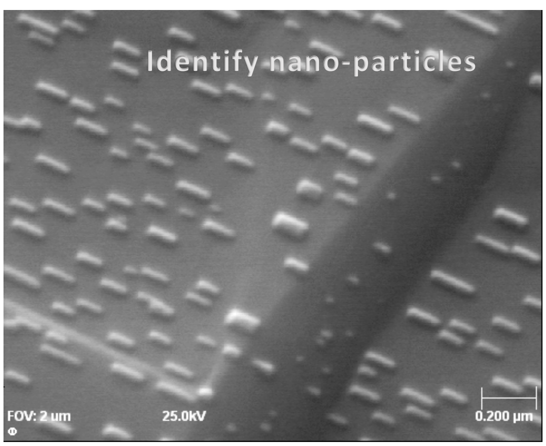
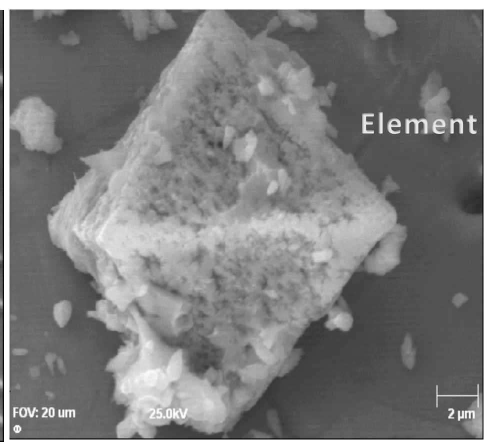
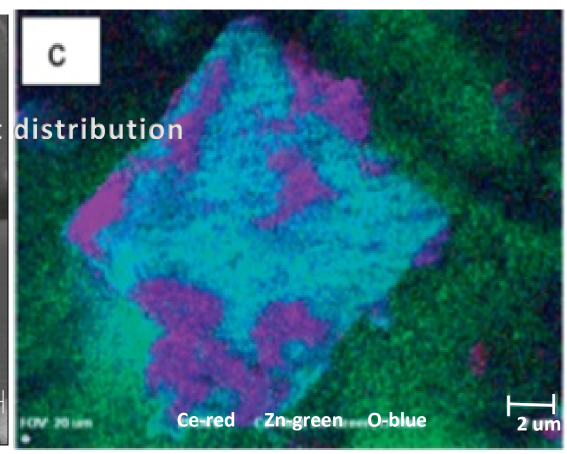
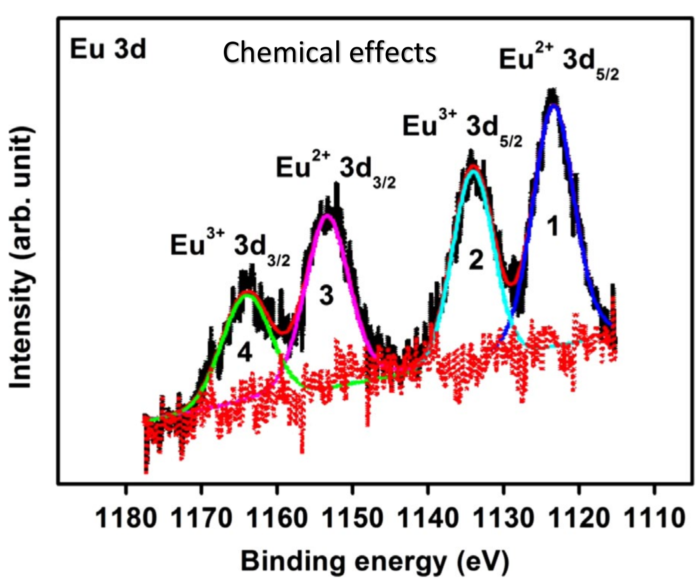
Surface characterization of Luminescent and Advanced materials

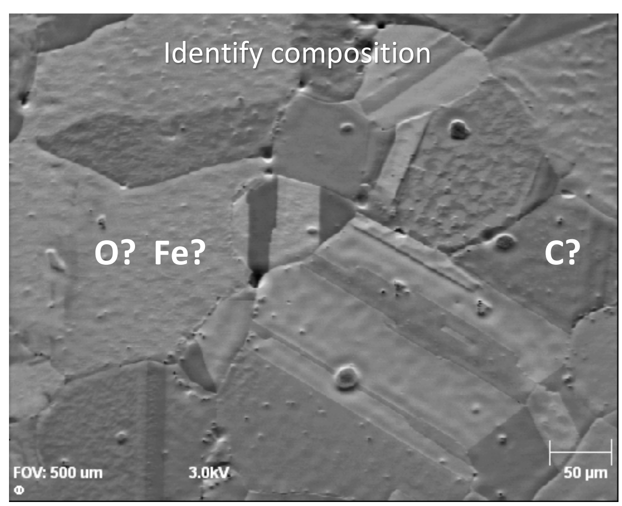
A: Auger electron spectroscopy (AES) and X-ray photoelectron spectroscopy (XPS) are highly specialized surface analysis techniques. This means that AES and XPS can be used to analyze the outermost atomic layers (< 10 nm) of a solid material. The manner in which any solid surface interacts with the environment or with another surface is forcing us to investigate the samples' surfaces. Answering questions about the composition, structure, optical, electrical and mechanical properties and chemical state of the outermost atomic layers is crucial in understanding many technologically processes. Examples of these processes are chemical reactions (such as oxidation, corrosion and degradation), catalysis, adhesion, thermionic emission, crystal growth, segregation and erosion.











B: Research in the field of Si solar cells focus on increasing the efficiency of the solar cells by minimizing the effects of the spectral mismatch. Photons with low energy will not be absorbed by the solar cells to generate electron-hole pairs. In the contrary, photons with energies much higher than the band gap of the solar cell will dissipate their energy as heat which is known as thermalization loss. Thermalization loss is accounted for the majority of the loss due to the spectral mismatch. This loss can be reduced through using a suitable luminescent layer that is able to convert the high energy photons like ultraviolet or blue photons into two lower energy photons through quantum cutting or the down-conversion processes. These converted low energy photons must be emitted in the infra-red (IR) regions were Si solar cells can absorb (± 1.1 eV or 1100 nm). Such a luminescent layer is called a spectral converter. Finding the ideal spectral converter lead to investigations done on SrF_2:Eu,Pr,Yb, CaF_2:Ce,Tb, $Y_2O_3:Bi^{3+}$, $Y_2O_3:Tm^{3+}$ and YOF:Bi,Ho luminescent materials. Investigations included different synthesis techniques to obtain powder and thin film samples, characterization in order to obtain the compositional, structural, morphological, chemical and luminescent properties. It also included some degradation studies. The best results obtained thus far were intense near-infrared (NIR) emission under Eu^{2+} sensitization in the SrF_2:Eu, Pr, Yb sample and IR emission enhancement for the YOF:Bi, Ho powders samples.