Line Defects in Single Crystal CeB₆ Electron Emitters
Nicholas Fairhart and Dr. Bill Mackie
Department of Physics, Linfield College, McMinnville, OR.

Abstract
Electron emitters are essential components in many microscopy systems, including scanning electron microscopes, transmission electron microscopes, and scanning Auger microscopes. One feature of good electron emitter materials is a low surface work function. CeB₆ is one such material. Line defects seen in CeB₆ affect the work function of the emitting surface, causing the emitted electrons to have a wider spread of energies. This causes chromatic aberration, reducing the resolution of the microscope.

Background
The work function is the minimum energy needed to remove an electron from the surface to use in electron microscope systems. Crystal defects contribute to chromatic aberration by having different work function than surrounding material. By having a different work function electrons leave at different velocities and are focused at different distances, adversely affecting resolution in microscopy systems.

Surface Analysis
The technique for analyzing these surface defects was time of flight secondary mass spectrometry or TOF-SIMS. Samples are bombarded with ions which eject secondary ions which are then detected by a time of flight detector.

Results
Field of view 55.7 µm
Field of view 1.5 µm
(a) Field of view
(b) Field of view

Future Work
Further explore the cause of the line defects. It is suspected the water contamination depositing oxides during fabrication process but this needs to be confirmed. Possible future experiments include baking the bulk material under vacuum before production to see if this removes water and defects.

Acknowledgements
I would like to personally thank Dr. Bill Mackie, without whom this project would not be possible, Dr. Jennifer Heath for driving down to Eugene and taking data with me, and Dr. Steve Golledge at the Center for Advanced Materials Characterization in Oregon for assistance with the TOF-SIMS measurements.

References