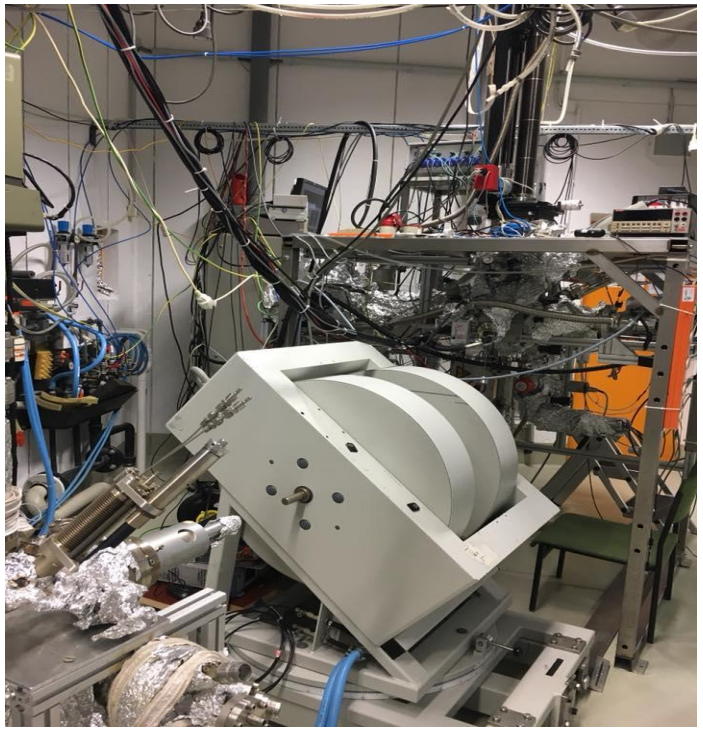
UHV Chamber Experience with DAAD RISE Internship

By Noah Donald



DAAD RISE

Research Internships
in Science and Engineering

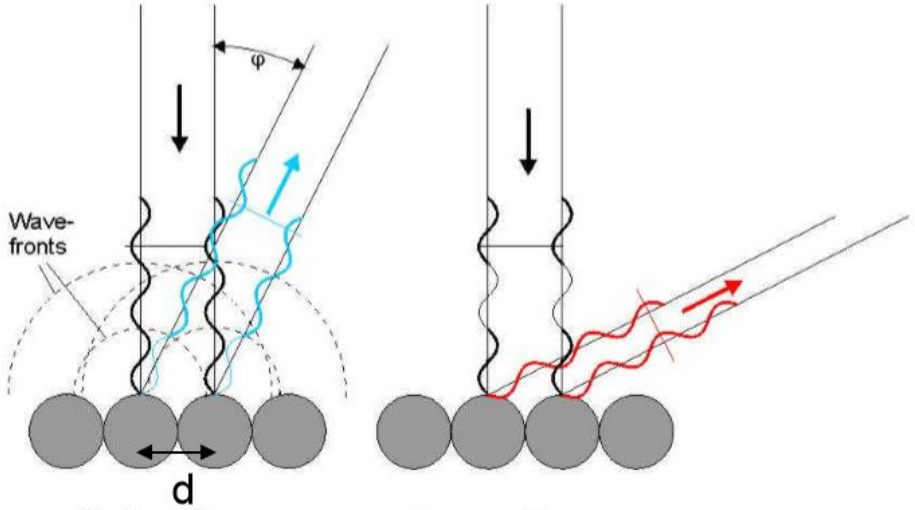
Introduction

- My Home University: The Ohio State University
- My Home City: Pittsburgh, Pennsylvania U.S.A
- Majors: Physics and Mathematics
- Places I have visited this summer: Amsterdam, Utrecht, Dusseldorf, Munster, Aachen, Koblenz, Bonn, Cologne, Bremen, Heidelberg, Antwerp, Ghent, Brussels, Luxembourg City, Barcelona.

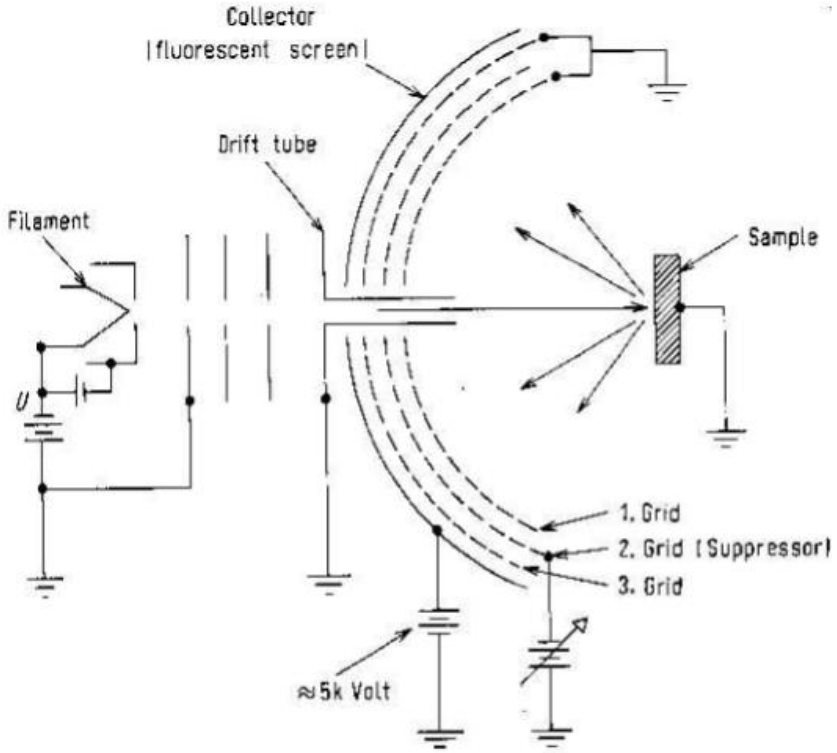
Experiences with UHV Chamber

- Procedures learned:
  - Preparing Samples
  - Transferring samples into and out of the chamber
  - Conducting LEED experiment
  - Conducting Auger Spectroscopy
  - Heating and Sputtering
  - Deposition of thin films on substrates
  - Bake out
- How I learned to operate the UHV Chamber:
  - Writing my own instruction manual: Lab Instructions.docx

The UHV Chamber: LEED Theory and Setup

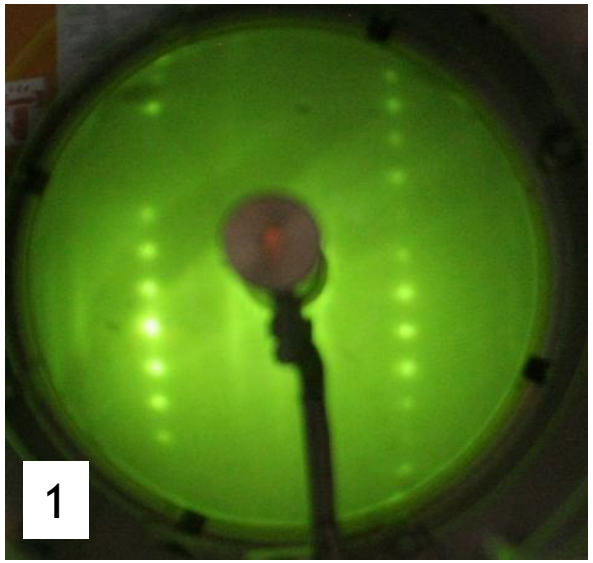


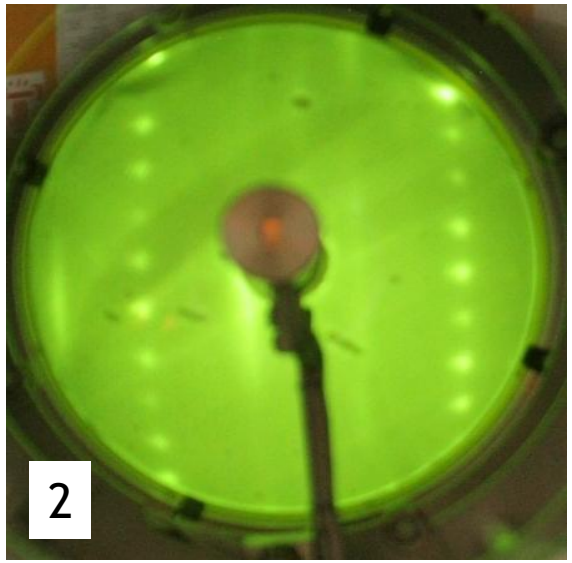
Ertl/Küppers Fig. 9.12, p. 217

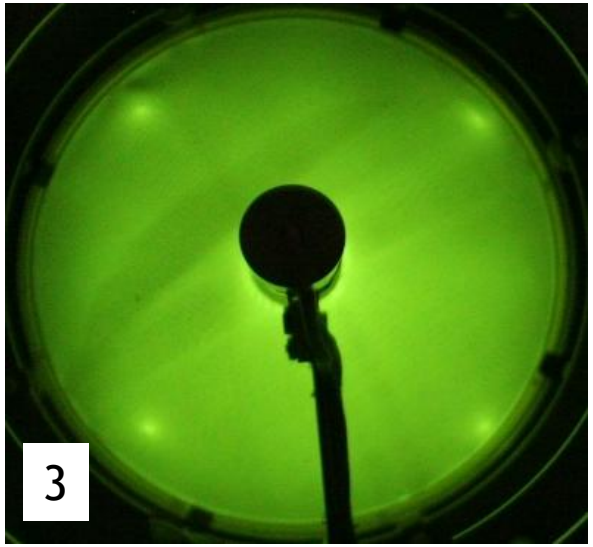


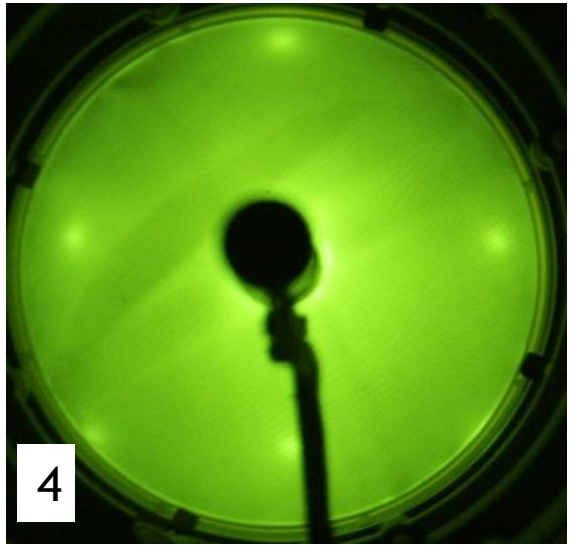
Ertl/Küppers fig. 9.7, p. 210

LEED Images and Qualitative Analysis









GaAs[100] after Sputtering and Heating:

1. Image taken at 63 eV on 6/25/2018
2. Image taken at 28 eV on 6/25/2018

Pressure: 5.5e-10 mbar

GaAs[100] & 4 nm Fe deposition:

3. Image taken at 117 eV on 6/26/2018
4. Image taken at 286 eV on 7/2/2018

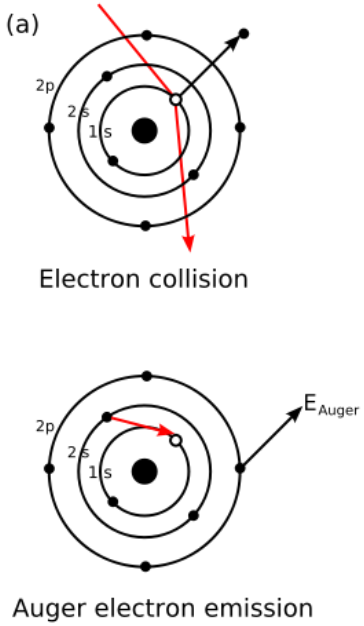
Pressure on 6/26/2018: 5.1e-10 mbar

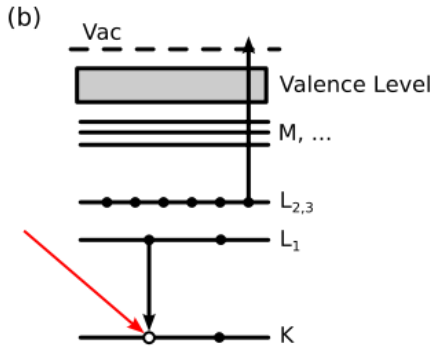
Pressure on 7/02/2018: 2.1e-10 mbar

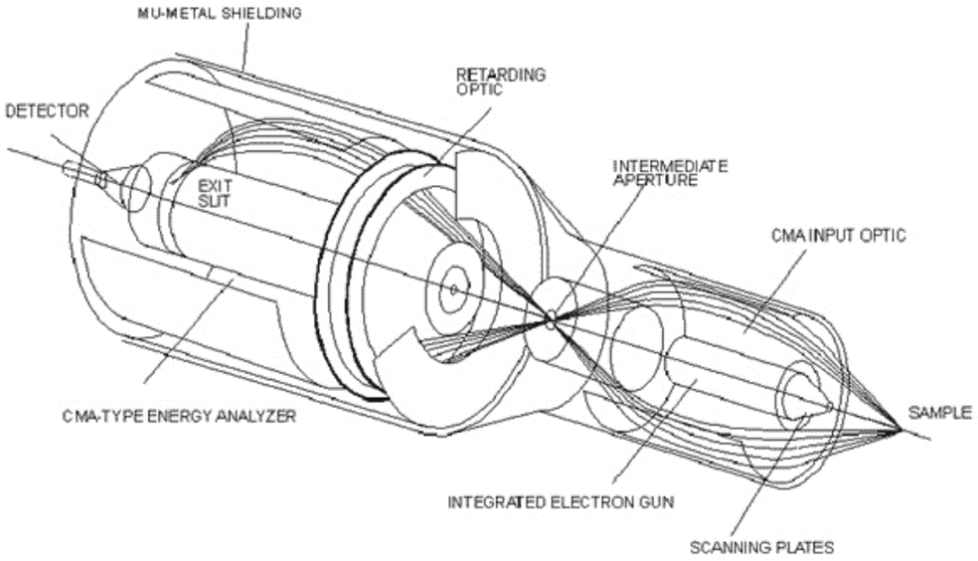
Surface Reconstruction Parameters:

1. Images 1 and 2 show a (1x6) reconstruction
2. Images 3 and 4 show a (2x2) reconstruction

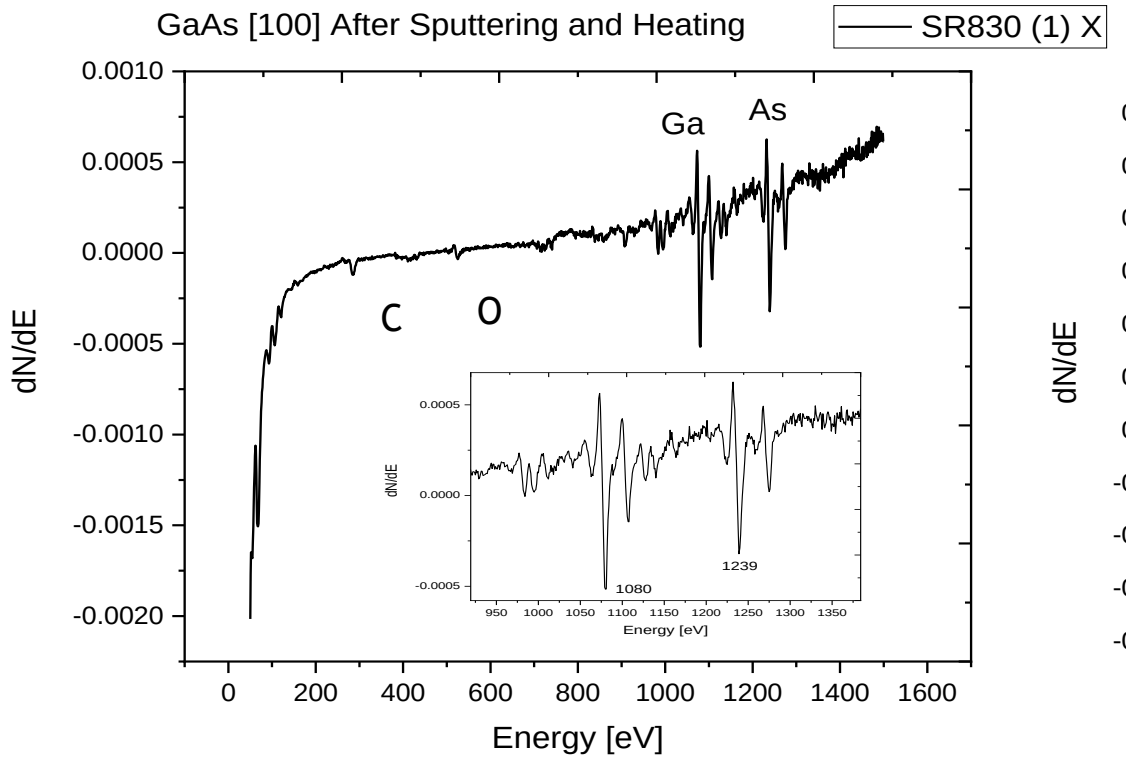
The UHV Chamber: AES Theory and Setup

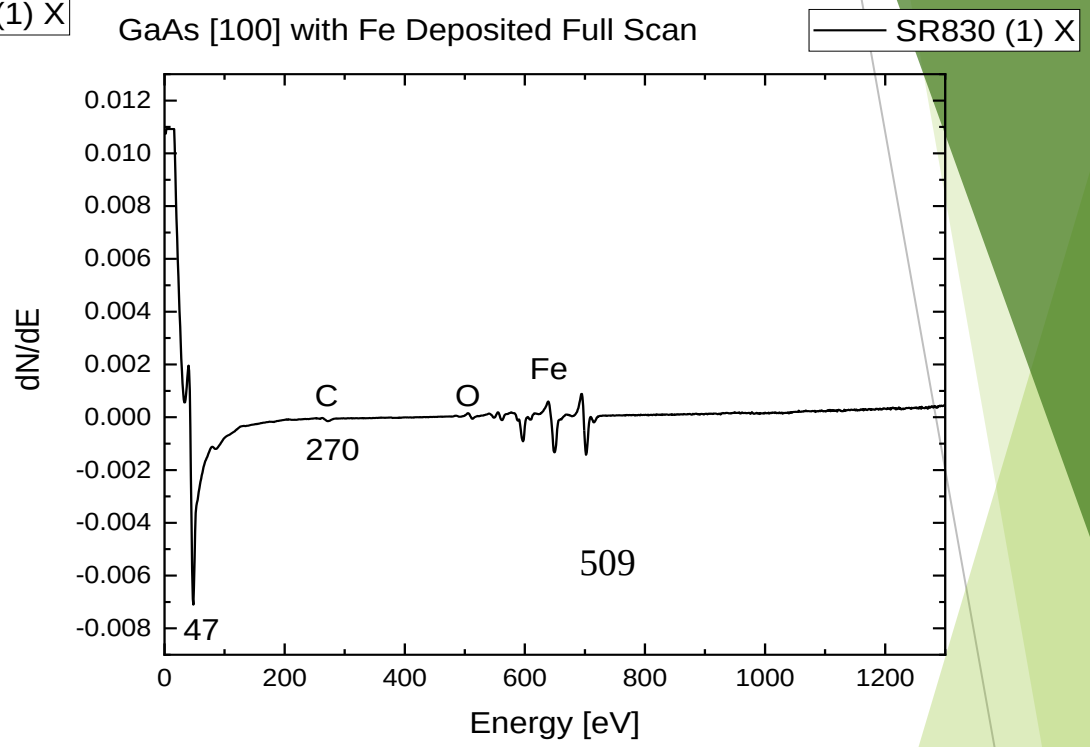






Analysis of Auger Spectrum





Percent Atomic Mass Concentrations:

Before Deposition:

- Ga: $33.9\% \pm 3\%$
- As: $66.1\% \pm 3\%$
- O: $1.3\% \pm 1\%$
- C: $2.1\% \pm 1\%$

After Fe Deposition:

- Fe: $90.9\% \pm 0.6\%$
- O: $3.5\% \pm 0.4\%$
- C: $5.4\% \pm 0.5\%$

Equations:

- $S_x(E_p) = \left(\frac{A+B}{A}\right)\frac{I_x^H}{d_x I_{Ag}^H}$
- $C_x = \frac{I_x}{S_x}\left[\sum_\alpha \frac{I_\alpha}{S_\alpha}\right]^{-1}$

Prof. Paul K. Chu, City University of Hong Kong

Conclusions

- I learned many different procedures and analyses to investigate the atomic level structure and composition of crystalline substrates in the UHV chamber context
- I gained lots of valuable laboratory experience
- The LEED images demonstrate the effect of iron deposition on the substrate, and this is confirmed by the Auger spectroscopy analysis
- I learned a lot about research in Germany, the great people who are doing it, and the vibrant culture this area of Europe has to offer

Thank You!