Organic Substrate Project Fall 2025

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Advised by Stefan Bell

Problem & Objective

Problem:

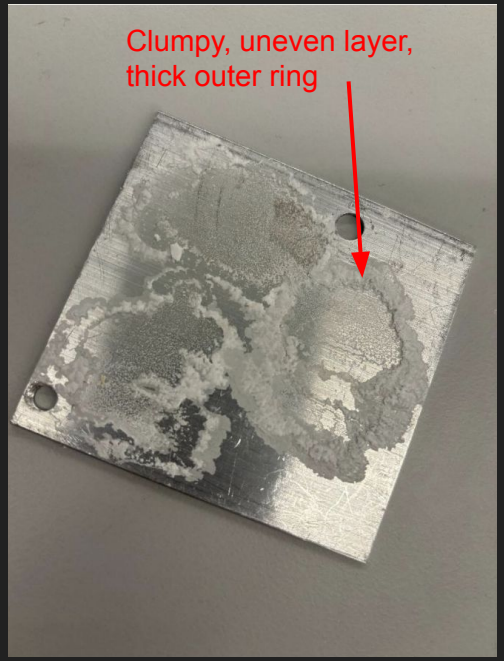
- Mass Spectrometry measurements perform better with uniform, reproducible surfaces
- Variability between samples makes results hard to compare
- Consistent, uniform coating needed for accurate and reliable measurements

Objective:

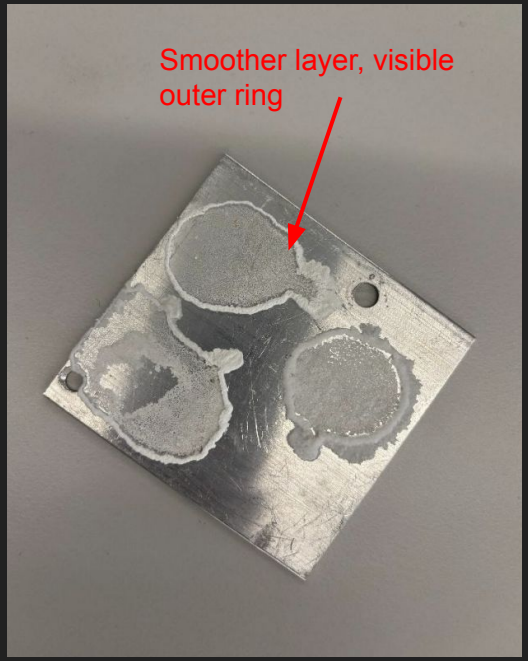
- Develop a method to deposit a uniform layer of organic material onto a substrate

Our Method

- Began with salt to figure out a good mass of organic to water ratio
- Tested with several solutions ranging from 1-2g of salt in 10 g of water
- Evaporated water from solution by sun-drying and heating with hot plate
- Found that 1.25g of salt + 10g of water solution created the most even layer with the hot plate
- Tested hot plate at different temperatures
- Found that hot plate at 125 degrees celsius created the most uniform layers



85 Degrees Celsius preheated



125 Degrees Celsius preheated

100 Degrees Celsius preheated

from the top in the middle and going counterclockwise, 1.25 of salt in 10g of water, 1.5 g of salt in 10g of water, 1.75 g of salt in 10g of water

Our Method cont.

- Following successful tests of the salt, we conducted the experiment again and were met with relevantly similar results
- From here, we shifted our focus to essential amino acids we are interested in detecting such as L-Arg HCI, Histidine, and Glycine.
- We wanted to ensure that our method worked on a variety of different organic materials.

Our Method cont.

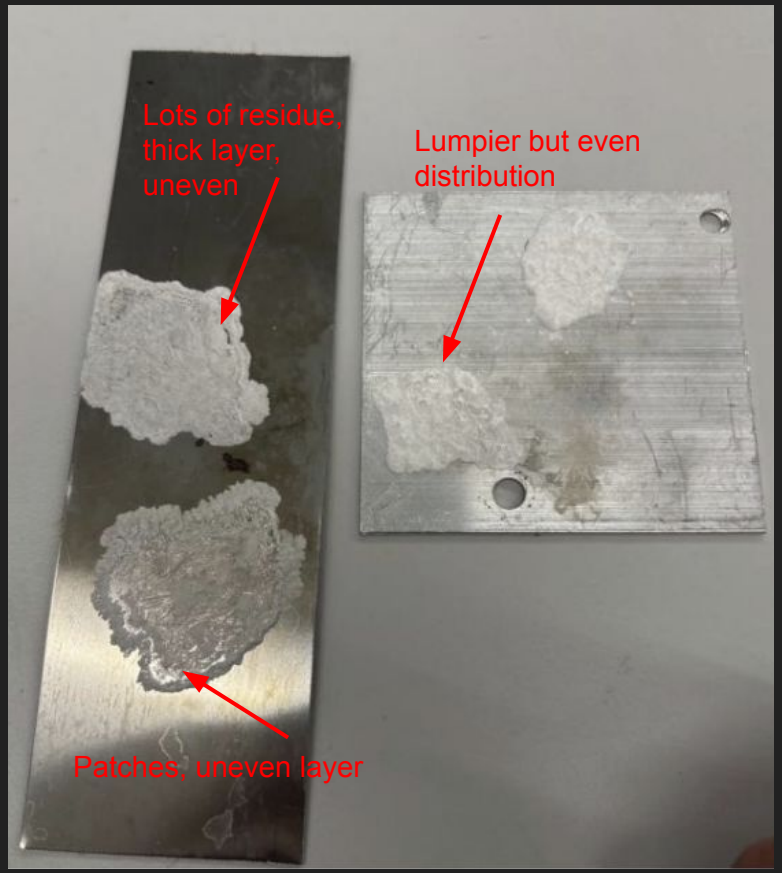
- Tested with L-Arg HCl solutions with 1.25g and 1.5g in 10g of water
- Wanted to see if plate material affected layer → Tested with aluminum and steel plates at 125 degrees celsius
- Found that and aluminum produced the smoothest coating but required longer heating in comparison to steel
- Conducted the same test but with Glycine

More uniform, no significant crystallization visible

1.25g L-Arg HCl + 10g water solution
Aluminum Plate

Uneven surface, thick layer, slight crystallization

1.25g L-Arg HCl + 10g water solution
Steel Plate



1.5g glycine + 10g water solution

1.25g glycine + 10g water solution

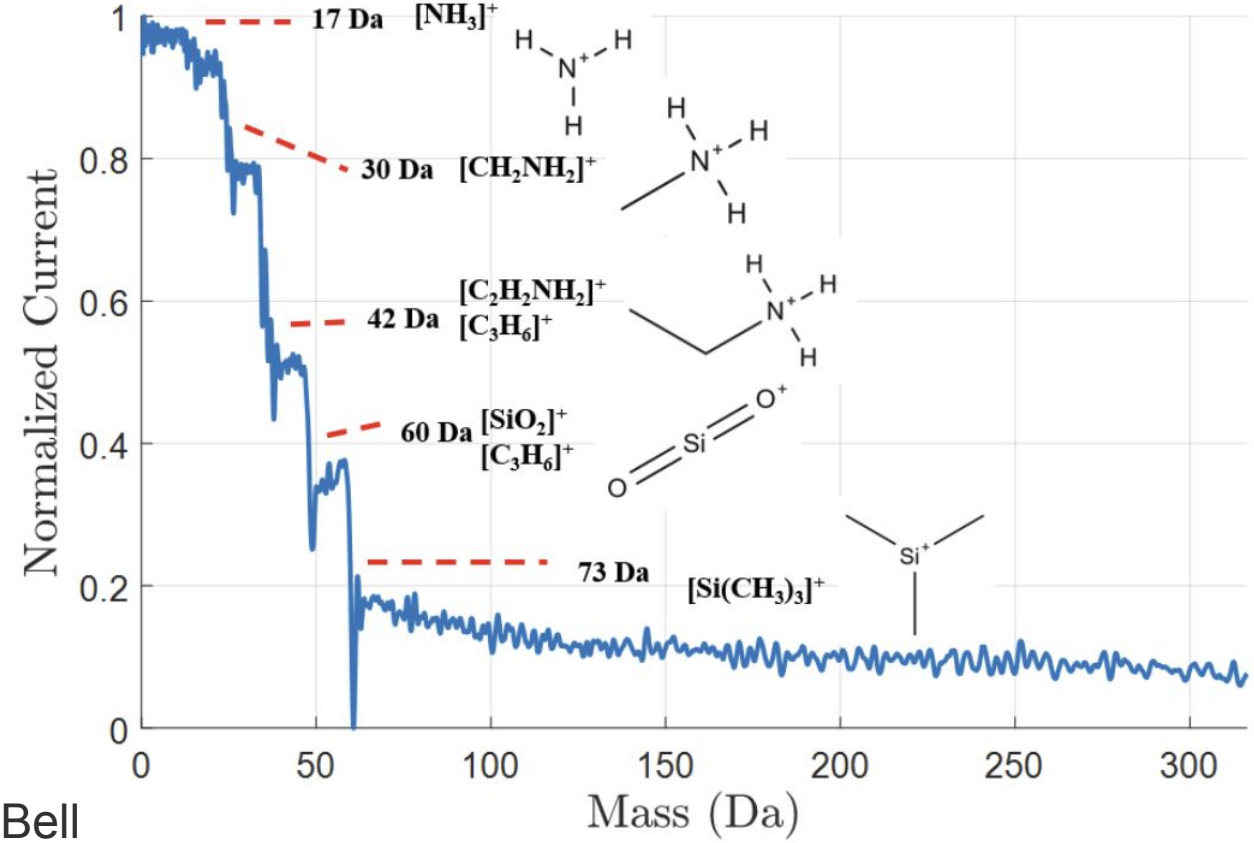
Mass Spectrometry of Histidine

- Failed to consider the molarity of the solution → Caused histidine sample to take too long to dissolve
- Created a more diluted solution with 1.25g of histidine and 40g of water
- For the mass spectrometry, we utilized the vacuum chamber to evaporate the water in the solution, the results looked similar when we dried it on the hot plate
- Had to manually scrape off material as to cover our substrate completely, multiple layers were needed to cover empty spots

Au-coated wafer

SRC V: -3000

TAR V: +4000

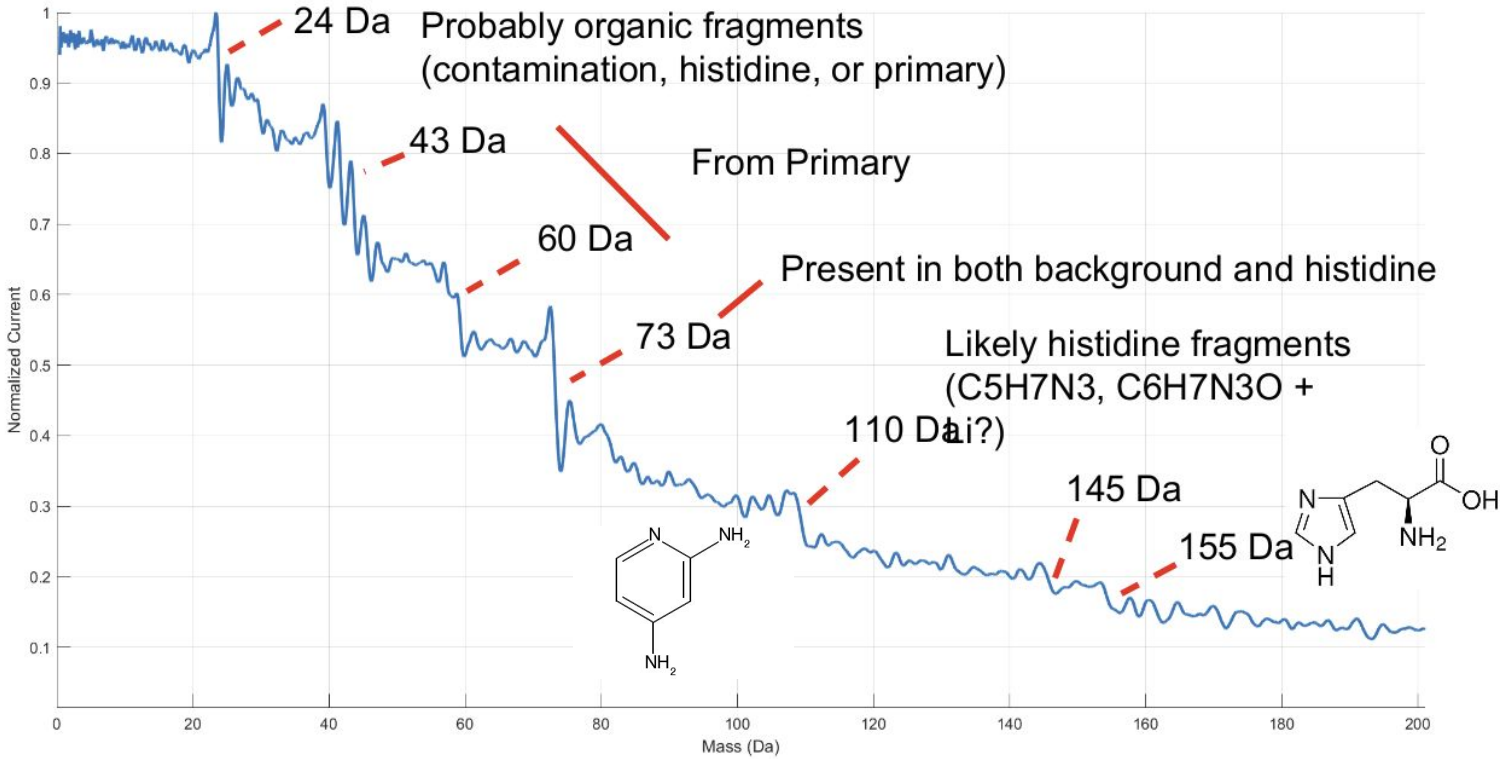


Credits to Stefan Bell

Histidine powder on Al block

SRC V: -3000

TAR V:
+5000



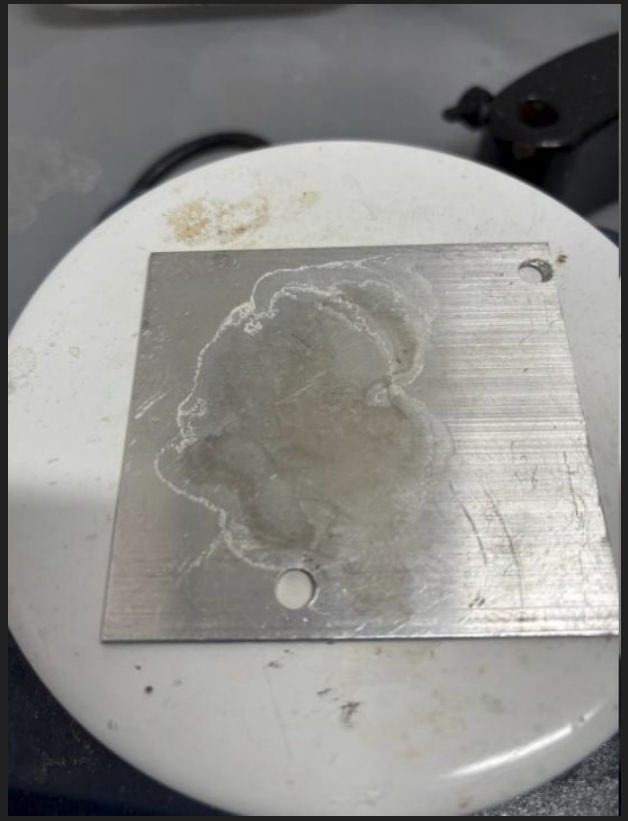
Credits to Stefan Bell

Future Plans

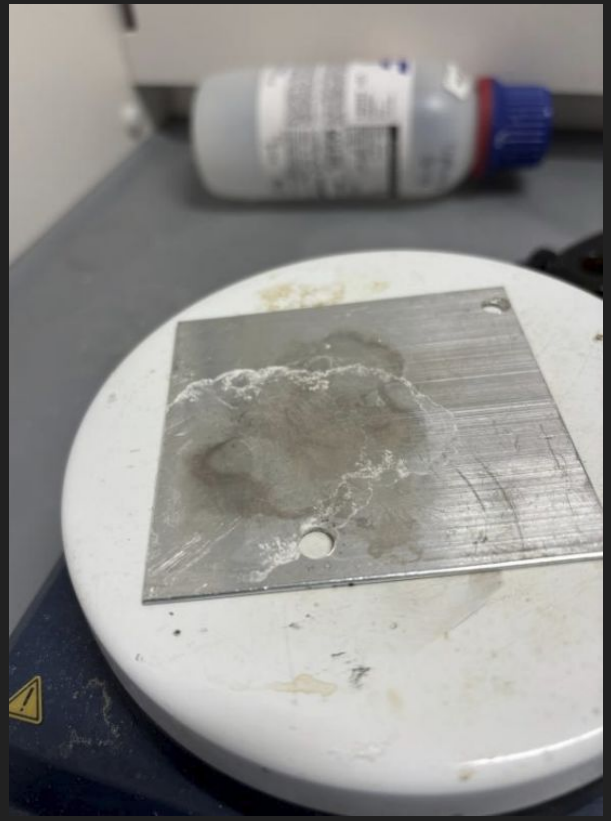
- Currently conducting tests with much lower molarities of organic solutions
- Had some success but still need to determine approximate molarity of solution + number of layers that work best
- Want to extend the method (once finalized) to other organic material and observe variations in behavior
- For reference, Mass Spec conducted on a 0.644 M solution

0.00644 M Histidine Solution on Steel
5 layers of solution

0.0644 M Histidine Solution on Steel
5 layers of solution

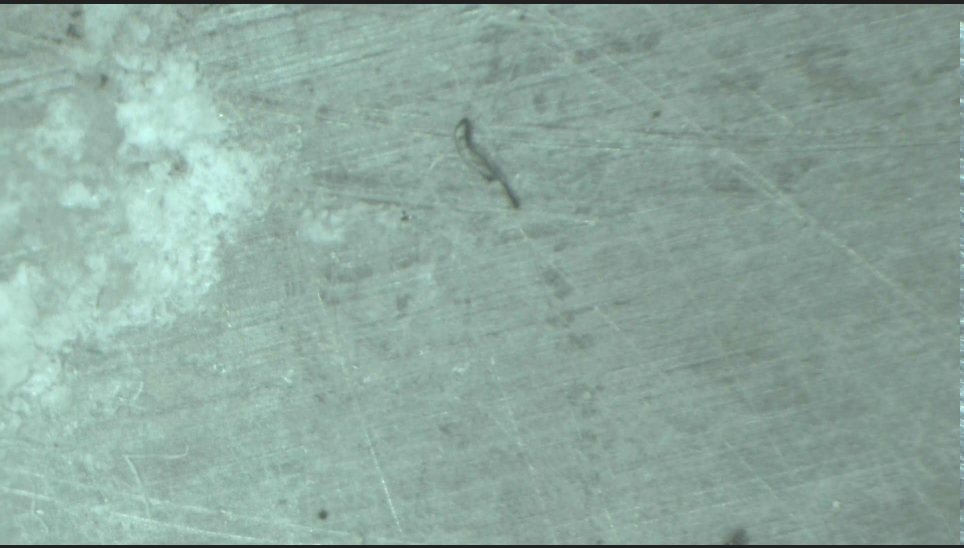


0.00644 M Solution on Aluminum | 5 layers

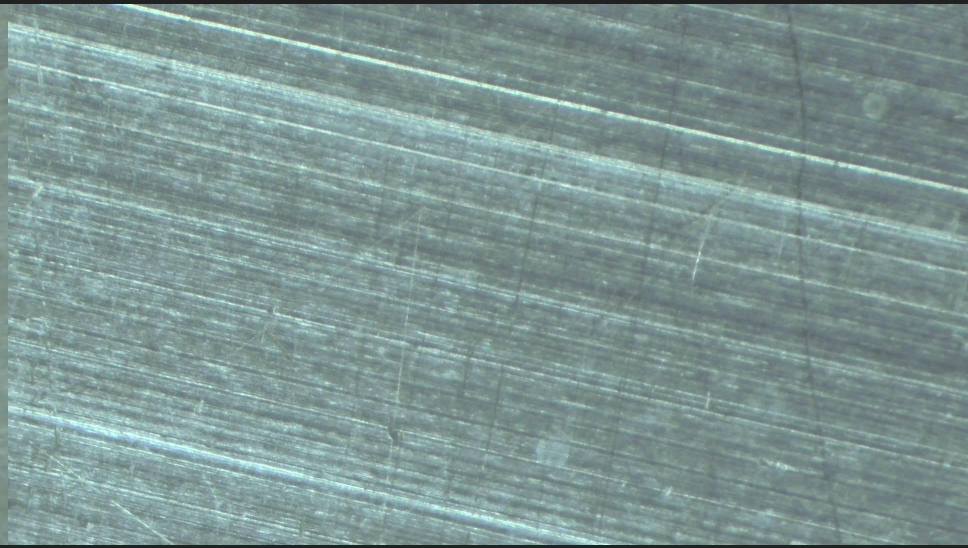


0.0644 M Solution on Aluminum | 5 layers

Under the microscope (aluminum)

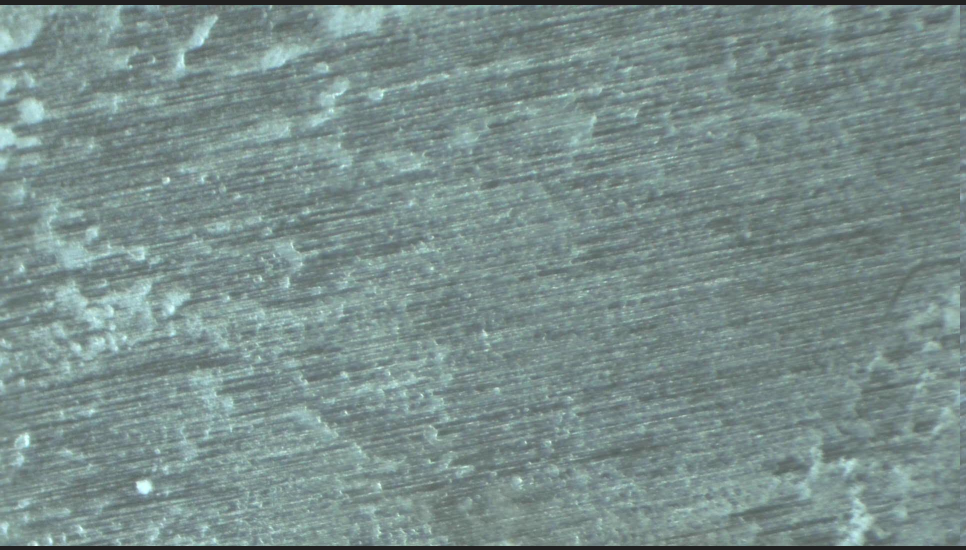


With the organic material

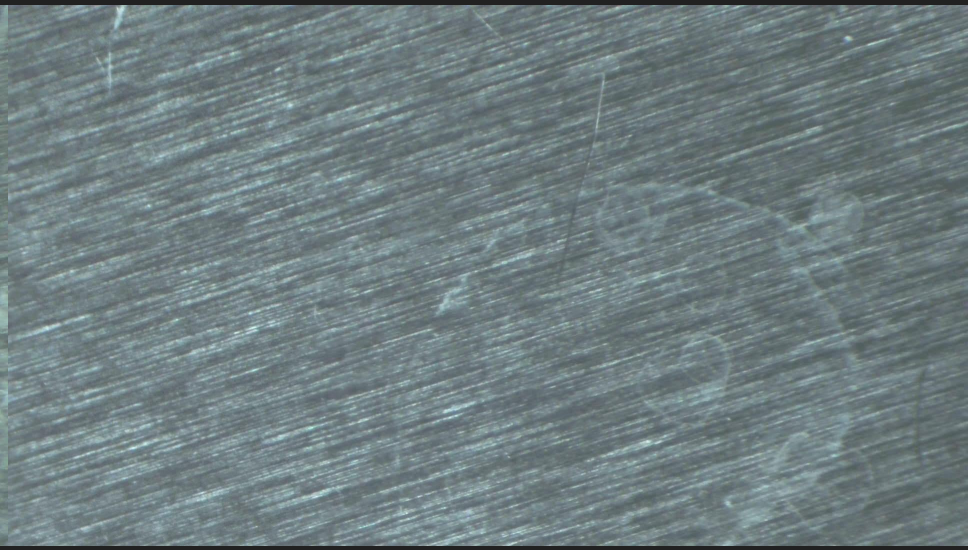


Without the organic material

Under the microscope (steel)



With the organic material



Without the organic material

Thank You

We’d like to give a huge thanks to Professor Petro for the opportunity to work in the ASTRA Lab, and to our advisor Stefan Bell for his guidance and mentorship.