

Betty A. and Donald J Baumann Family Scholarship Fund Application Form

1. Name

Alex Lang, ALA02200

2. Chemistry Faculty Research Director

Dr. Eric Villa

3. Proposal

Structural Divergence of Heavy Metal Complexes with Isomeric Thiophenecarboxylates

I am a member of Dr. Eric Villa's inorganic research group in the Creighton University Department of Chemistry. I have been able to perform undergraduate research with him for over one year, including this past summer through the Ferlic Fellowship Program. Through working with him, I have been able to present my research at the American Chemical Society's 2018 Midwest Regional Meeting earlier this semester.

The focus of my research has revolved around the structural difference observed when 2- and 3-thiophenecarboxylate (TCA) ligands are used in the formation of metal-organic frameworks (MOF's). TCA's have emerged as exciting ligands highlighted in recent publications due to their interesting chemical structures and properties. While a fair amount of research has focused on thiophene-dicarboxylates, the thiophene-monocarboxylates have not yet been extensively explored. TCA's interesting structure is comprised of two components: the carboxylate group and the thiophene ring. The carboxylate group has been shown to readily bond to a variety of heavy metals across the periodic table in the P, D, and F blocks to form MOF's. The aromatic thiophene ring has

been shown to absorb light well. These two properties have allowed TCA's to bond to different metals and enhance weak *f-f* Laporte forbidden transitions of lanthanides.

Identical reaction conditions have yielded starkly different networks when the sulfur position is varied. This exciting discovery shows the diversity of MOF's and how dependent they are upon formation conditions. We have discovered novel crystal structures of Pr³⁺ and TCA at room temperature in multiple solvents as well as elevated temperature conditions. We have analyzed the different crystals using X-Ray Diffractometry and solved the crystallographic structures using Shel-Xt. The extended structures consistently varied when the ligand was changed from 2- to 3-TCA. The exact reason for this is unknown, but it will likely lead to varied luminescent properties.

The next step of this project is to perform room temperature and hydrothermal syntheses with 2- and 3-selenophenecarboxylate. We plan to synthesize these ligands with the direction of another Creighton chemistry faculty, Dr. Martin Hulce. This will allow us to determine whether the crystals formed are unique to thiophene-derivatives or whether the thiophene group can be substituted for similar aromatic rings, further exploring the range of luminescent properties. Selenophenecarboxylate was chosen because selenium and sulfur are both chalcogens. Furthermore, furan-carboxylate may be studied as well since oxygen also a chalcogen.

4. Presentation of research results (past and future conferences, publications, seminars, etc.)

With the help of this scholarship, I will be able to present this research next spring at St. Albert's Day and the ACS National Meeting in Orlando, Florida. I will work with Dr. Villa towards finding experimental trends in the structures when experimental conditions are varied. This will hopefully lead to a publication.

5. Post-graduate plans (job market, graduate school, medical school, etc.)

After graduating from Creighton, I plan to attend graduate school for inorganic chemistry. I plan to pursue a PhD in either organometallics, inorganic chemistry, catalysis, or energy storage. Ideally, I would love to teach at a Primarily Undergraduate Institute after obtaining a higher degree so that I can build personal relationships with students like the ones I have built with the faculty here at Creighton.

6. Number of semesters completed in research, including the current semester (summers count as two semesters).

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7. Anticipated graduation date:

May, 2019

Applicant signature

Chemistry research director's signature