University Alliance for Sustainability

Final Report: Research Stay at University of British Columbia

M. Sc. Lisa Suntrup

Freie Universität Berlin

PhD (4th Semester) in Chemistry

Catalysis for Energy Relevant Research: (Sun)light as a Sustainable Energy Source

May, 2nd to June, 26th 2016

I spent about 8 weeks at the University of British Columbia in the Chemistry Department. The first four weeks of my research stay were funded by the University Alliance for Sustainability, another four weeks were then generously financed by my hosts, Professor Curtis Berlinguette and Professor Michael Wolf from the Chemistry Department of UBC. Our joint project on the development of photoredox-active catalysts for CO_2 reduction started in February during a symposium at the Freie Universität Berlin. It was then decided that I should bring a selection of transition metal complexes that were synthesized and electrochemically characterized in our group to Vancouver to further investigate the possibility of using these compounds as photoredox catalysts. I was glad to find that weeks before my arrival I had a contact person at UBC, namely the assistant of Prof. Berlinguette, who provided me with all the necessary information and paperwork as well as helpful hints for accommodations for my stay in Vancouver. Upon arriving I was directly provided with a contact person within the research group of Prof. Berlinguette who helped me with the formal organization during the first weeks of my stay. It has to be mentioned that my active time spent in the laboratories was slightly shortened by the numerous safety trainings and tests I had to complete before I was legally allowed to work in the research laboratories. This might be useful information for future students applying for this program when planning the duration of their stay. I spent most of my time in the Berlinguette group, which gave me a great insights into a different part of small molecule activation: Coming from a background of molecular catalysts, it was interesting to see techniques and the development of new materials from a heterogeneous perspective, and to be part of discussions, seminars and group meetings of practical problems in this field. This was helpful to better understand the very different problems and strategies (both from a chemical as well as an engineering point of view) regarding large scale applications in small molecule activation, in this case CO_2 reduction and water splitting. Part of my research during this stay was to conduct further

spectroscopic measurements on my compounds: regarding this, I was supported by several of the PhD students from the Berlinguette and the Wolf group. This was probably the most challenging aspect of my stay: to coordinate all the measurements and information with several people who do not work together on a daily basis; to put together all the necessary data and information that I needed from various directions and to communicate which measurements I wanted to do for the respective purpose. But this worked out well due to the PhD students, who were very forthcoming and willing to work out problems as they came, and we could determine the excited state lifetimes of the complexes under different conditions via transient absorption spectroscopy as well as the absorption and fluorescence properties, both of which were compared to a well-known benchmark compound to assess the future application in photocatalysis. We could see that the excited state lifetimes were comparable, which makes our compounds suitable candidates for the application in photocatalytic CO_2 reduction, as well as potential photosensitizers in other reactions such as water splitting. I was also able to test my compounds in the electrochemical CO_2 reduction using different setups. This was important to see if our catalysts are selective enough to be useful for future applications. The experiments confirmed that the catalysts are completely selective towards the formation of carbon monoxide; in combination with the results from the spectroscopic measurements, we are now able to use these complexes as photocatalysts for the aforementioned applications.

Looking back, I have to praise the work environment at UBC; the supervisors and the other students in both groups were very helpful and open for discussions on the different problems during measurements or the theory behind it. I am sure that in the future, we will continue our joint project with both groups and would like to have another student exchange to keep up the work that we started in those few weeks and to further improve the photocatalytic system and the conditions.