Ariana La Rosa

Saint Peter's University, Class of 2021
Major: **Biotechnology and Biochemistry**

Faculty Advisor: **Yosra Badiei, Ph.D.,** Assistant Professor
Department of Chemistry

Ruthenium Water-Oxidation Catalyst Based On Amide Ligands

Artificial photosynthesis (AP) is a process by which renewable and clean energy can be stored in the form of hydrogen fuel. The water-oxidation reaction is the half-reaction in natural photosynthesis and AP where water is converted to oxygen, electrons and protons with the help of an oxygen-evolving catalyst (OEC). This is a critical step to provide a sustainable source of electrons and protons needed for the production of clean fuels. Inspired by nature, and to effectively reproduce the reaction in AP, the synthesis and discovery of an efficient oxygen-evolving catalyst complex are essential. Previous work on synthetic OECs has identified some ruthenium complexes to be highly efficient. However, there is no clear understanding of the structure-activity relationship of how ligands impact the catalytic mechanism. In this research, we aim to compare the oxygen evolution activity of two ruthenium(II) complexes containing carboxylate (RCOO-) and amide (RCONH-) ligands. Amide ligands are known to exhibit stability and robustness in aqueous solutions. We were able to synthesize a Ru(II) complex that contains N,N'-bis(aryl)pyridine-2,6-dicarboxamide. A comparative catalytic oxygen evolution study of the Ru(II) amide complex to the known water-oxidation complex Ru(II) carboxylate was performed. The study was performed using an Ocean Optics oxygen gas sensor in a gas-tight side-arm vessel. The effect of pH on the catalytic activity for both complexes will be also shown.

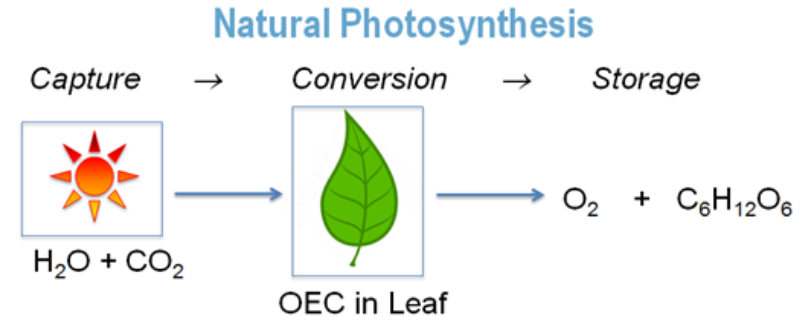
Independent Colleges Undergraduate Research Award Recipient 2020

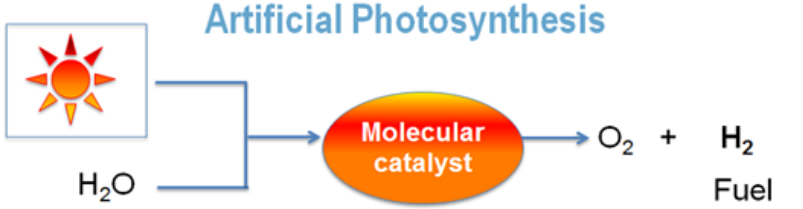
Additional Funding: ***Hilsdorf Chemistry Department***

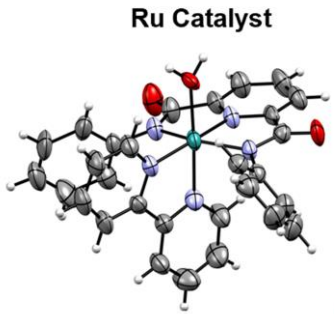
A Ruthenium Water-Oxidation Catalyst Based On Amide Ligands

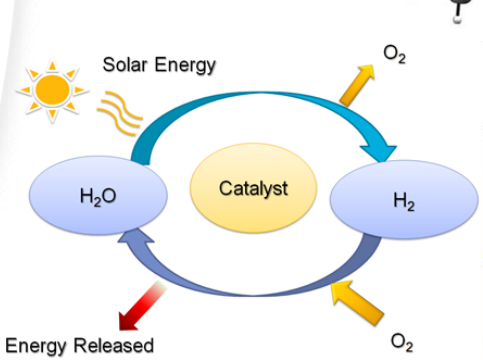
Ariana La Rosa, Alejandro Gomez Gonzalez, and Dr. Yosra M. Badiei*

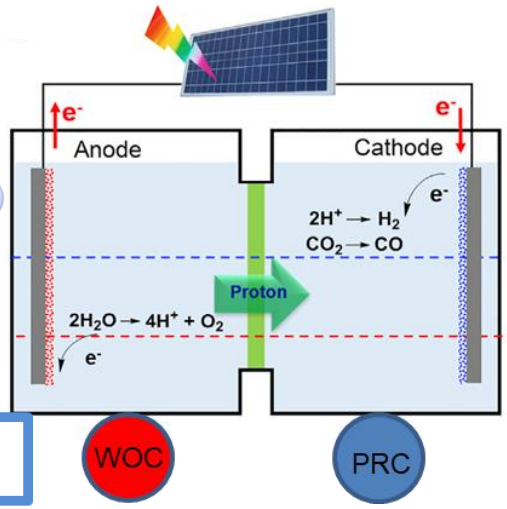
- **Artificial photosynthesis** is a process by which renewable and sustainable clean energy can be stored in the form of hydrogen fuel.
- Objective:
  - Design, characterization and identification of new Ru water-oxidation catalysts.
  - Better understanding of the mechanism and intermediates.











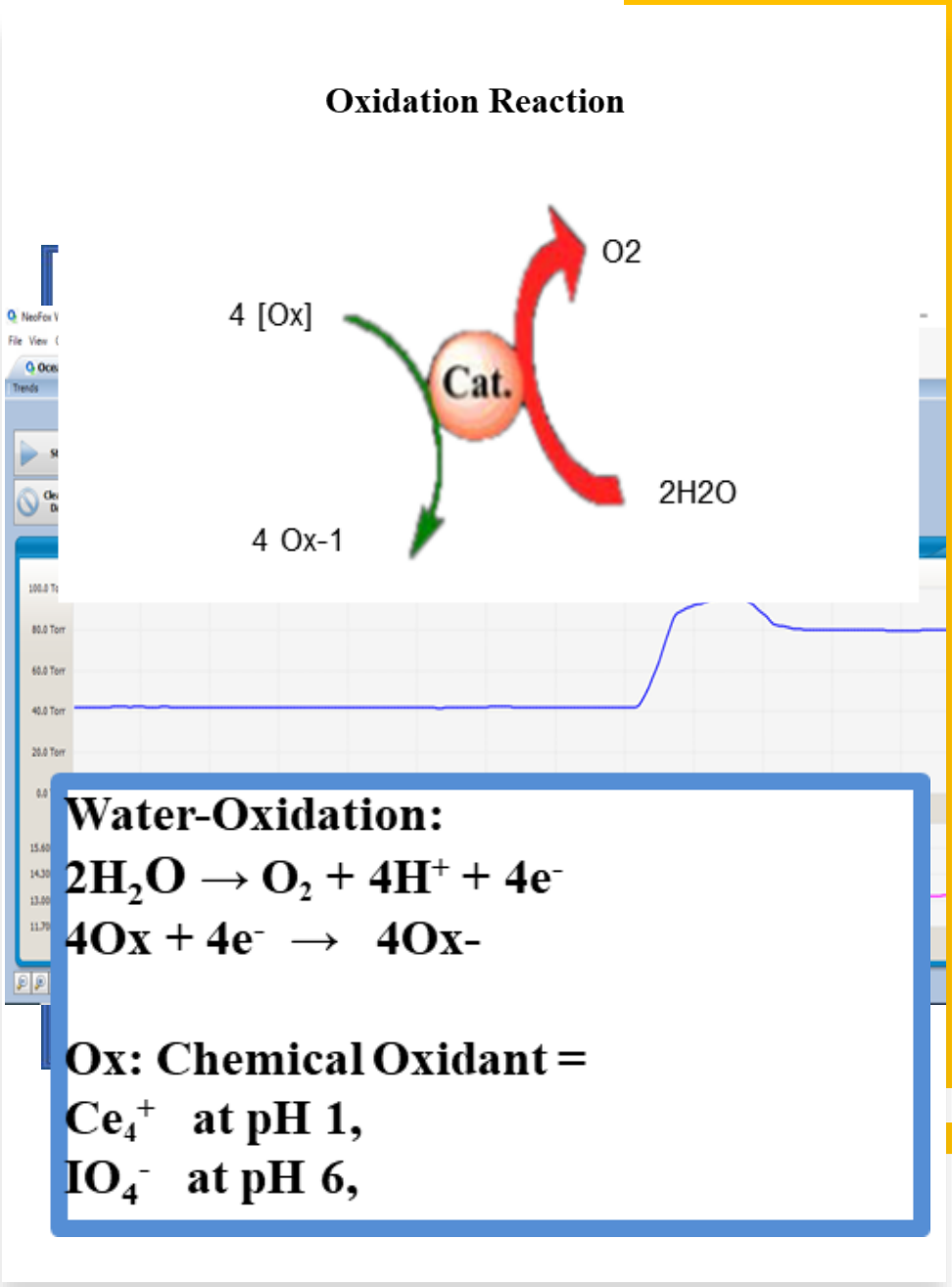
Water-Oxidation:
$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ $E^0 = -1.23V$

F. Li, H. Yang, W. Li, L. Sun, Joule, 2 (2018) 36-60.

INDEPENDENT COLLEGE FUND OF NEW JERSEY
Saint Peter's UNIVERSITY
The Jesuit University of New Jersey

Methodology

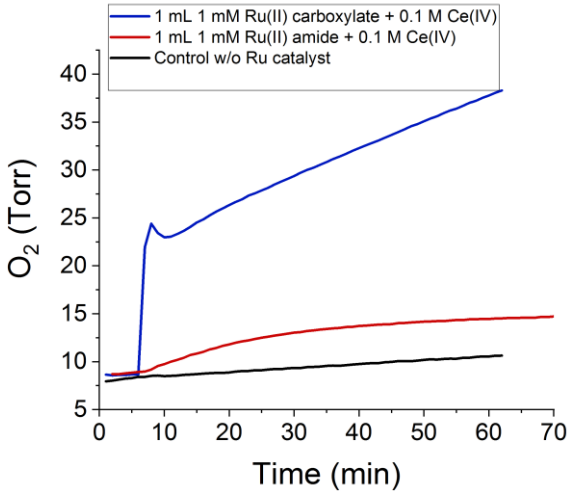
Ocean Optics Oxygen Sensing Probe Equipment

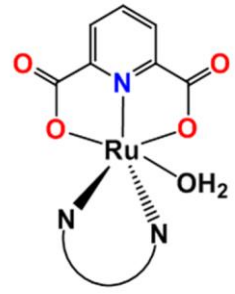


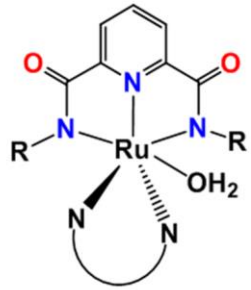
Results

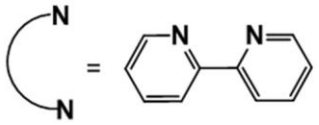
Ru-carboxylate vs. Ru-amide

Oxidant: 0.1 M CAN in 0.1 M HNO_3 (pH 1)

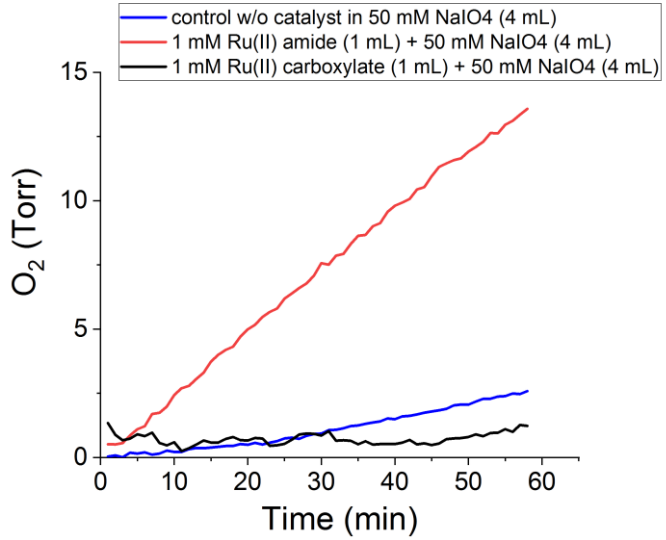








Oxidant: 50 mM $NaIO_4$ in 0.1 M NaH_2PO_4 (pH 6)



$$TON = \frac{\text{moles of O2}}{\text{moles of catalyst}}$$

Catalyst	Oxidant	pH	TON
Ru(II) amide	Ce(IV)	1	5
Ru(II) carboxylate	Ce(IV)	1	42
Ru(II) amide	$NaIO_4$	6	49
Ru(II) carboxylate	$NaIO_4$	6	< 2