

EPFL Valais, ChE 602 Seminar, 17.11.2016

*Title: Towards Artificial Photosynthesis: Molecular and Materials Design for Water Oxidation*

**Abstract:**

Artificial photosynthesis has been in the focus of worldwide clean energy research for decades, because it provides direct access to hydrogen through solar-light-driven water splitting. However, the development of efficient water oxidation catalysts remains a major bottleneck to master this demanding half reaction of water splitting on the way to technological implementations.[1]

The talk will start with a basic overview of the current challenges of water oxidation catalyst (WOC) design together with an introduction to the UZH Research Priority Program LightChEC (Light to Chemical Energy Conversion).

In the first part, our bio-inspired strategies to molecular WOCs along the lines of Nature's  $\{CaMn_4O_5\}$  oxygen evolving complex (OEC) will be presented. We aim to translate OEC features into efficient Co-based WOCs, which led to the development of the first cuboidal  $\{Co(II)_4O_4\}$  WOC with a flexible ligand environment.[2] The key functional elements of this Co-cubane WOC will be compared to the first series of highly sought-after active cubane WOCs combining mobile ligands with a bio-mimetic redox-inert center, namely the  $[CoII_3Ln(hmp)_4(OAc)_5H_2O]$  ( $Ln = Ho - Yb$ ,  $hmp = 2$ -(hydroxymethyl)pyridine) cubanes.[3] Crucial issues in molecular catalyst construction will be discussed, including core nuclearity, ligand architecture/exchange and the role of  $Ln^{3+}$  cations as  $Ca^{2+}$  mimics.

The second part of the talk will complement molecular catalysis with our recent strategies towards heterogeneous Co-containing WOCs, such as robust spinel- and perovskite-based systems. Special emphasis will be placed on  $La_{1-x}Sr_xBO_3$  perovskites ( $B = Fe, Co, Ni, \text{ or } Mn$ ) as model systems for electronic structure tuning as a straightforward strategy toward solid WOC optimization.[4] An outlook on unified WOC design approaches will round off the talk.

[1] M. D. Karkas, O. Verho, E. V. Johnston, B. Akermark, *Chem. Rev.* **2014**, *114*, 11863.

[2] F. Evangelisti, R. Güttinger, R. Moré, S. Lubner, G. R. Patzke\*, *J. Am. Chem. Soc.* **2013**, *135*, 18734.

[3] F. Evangelisti, R. Moré, F. Hodel, S. Lubner\*, G. R. Patzke\*, *J. Am. Chem. Soc.* **2015**, *137*, 11076.

[4] H. Liu, R. Moré, H. Grundmann, C. Cui, R. Erni, G. R. Patzke, *J. Am. Chem. Soc.* **2016**, *138*, 1527.

## **Curriculum Vitae: Greta Ricarda Patzke**

Department of Chemistry, University of Zurich,  
Winterthurerstrasse 190, CH-8057 Zurich  
\* 2 March 1974; phone: +41 44 635 4680;  
email: [greta.patzke@chem.uzh.ch](mailto:greta.patzke@chem.uzh.ch), [www.patzke.ch](http://www.patzke.ch)



### **PROFESSIONAL EXPERIENCE**

05/2016 *Full Professor*, Department of Chemistry, UZH  
05/2015 Full professorship offer  
(University of Florida/Gainesville: declined)  
05/2013 *Associate Professor* at the Institute of Inorganic Chemistry,  
University of Zurich  
05/2007 – 04/2013 *SNF Professorship* (tenure track), Institute of Inorganic Chemistry, UZH  
03/2008 Full professorship offer (Saarland University, Germany: declined)  
10/2006 *Venia Legendi* for Inorganic Chemistry (ETH Zurich)  
2000 – 2006 *Habilitation* period at the Department of Chemistry and Applied Biosciences,  
ETH Zurich (Mentor: Prof. Dr. Reinhard Nesper)

### **UNIVERSITY EDUCATION**

07/1999 PhD (*summa cum laude*) University of Hannover  
1997 – 1999 Graduate research fellow in the group of Prof. Dr. Michael Binnewies  
(Institute of Inorganic Chemistry, University of Hannover); PhD thesis:  
*Synthesis, Characterization and Properties of Mixed Oxides*  
06/1997 Diploma in Inorganic Chemistry (*passed with distinction*)  
1993 – 1996 Undergraduate studies at the University of Hannover (Germany)

### **FELLOWSHIPS AND AWARDS**

2007 – 2013 *SNF Professorship* of the Swiss National Science Foundation  
2009 Forum member: *NCCR Materials with Novel Electronic Properties (MaNEP)*  
09/2006 *Alfred Werner Assistant Professorship*, Alfred Werner Foundation (declined)  
1997 - 1999 PhD Scholarship (*German National Academic Foundation*)  
1997 PhD Fellowship (*Chemical Industry Fund of the German Chemical Industry Association*) (declined)  
1993 – 1996 Undergraduate fellowship of the *German National Academic Foundation*  
07/1993 25<sup>th</sup> International Chemistry Olympiad; Italy (Gold medal)

### **MEMBERSHIPS AND EXTRAMURALS (selected)**

- Board Member / University of Zurich Research Priority Program LightChEC:  
*Light to Chemical Energy Conversion*
- ZURICH.MINDS (science, arts and business leaders, invitation-only): [www.zurichminds.org](http://www.zurichminds.org)
- Editorial board member of *Polyhedron*, *Materials* and *Inorganics*

### **KEY RESEARCH INTERESTS**

- Development of functional oxide nanomaterials (water oxidation and other catalysts, sensors)
- Polyoxometalate design for artificial photosynthesis and magnetic materials
- Oxide materials for solar thermochemical water splitting
- Bioactive nano-hybrids of oxoclusters and biomacromolecules (new antimicrobial materials)