



Water oxidation catalysts and a turned hydrogenase for solar hydrogen production.

Stenbjörn Styring

Molecular Biomimetics, Department of Chemistry-Ångström, Uppsala University, Box 523, SE-751 20 Uppsala, Sweden

Stenbjorn.Styring@kemi.uu.se

In the Swedish Consortium for Artificial Photosynthesis^{1,2} we develop both manmade, artificial photosynthetic systems and photosynthetic microorganisms for solar fuel production.

We design and synthesize catalysts for light driven oxidation of water, an essential part of all solar fuel production methods. The lecture will describe a water-oxidizing cobalt nano-particle³. This nano-particle has been linked to a photosensitizer to form a water-splitting photosensitizer-catalyst complex⁴. Using MIMS (membrane inlet mass spectrometry) we have resolved the detailed catalytic mechanism in this nanoparticle⁴. Recently we have applied EPR spectroscopy to study the catalytic mechanism in a series of extremely efficient, molecular Ru-catalysts for water oxidation⁵. An unexpected outcome of this research is that water is bound in what seems to be an unusual seventh ligand position, already in the Ru(III) oxidation state.

The lecture will also describe a spectroscopic study on the uptake hydrogenase from *Nostoc punctiforme* electron transfer relay⁶. Normally this enzyme oxidizes hydrogen (H₂) but by exchange of one amino acid in the electron transfer relay with three FeS clusters, the electron transfer is turned towards H₂ formation⁶. This work is taken further and EPR studies indicate that the proximal FeS cluster involves Fe-ligation with an asparagine which is a quite uncommon ligand.

References

1. Magnuson, A., Anderlund, M., Johansson, O., Lindblad, P., Lomoth, R., Polivka, T., Ott, S., Stensjö, K., Styring, S., Sundström, V. and Hammarström L. (2009) *Accounts Chemical Res.*, **42**, 1899-1909
2. S. Styring (2012) *Faraday Discuss.* **155**, 357-376
3. Shevchenko, D., Anderlund, M. F., Thapper, A. and Styring, S. (2011) *Energy and Environmental Science*, **4**, 1284-1287
4. Koroidov, S., Anderlund, M.F., Styring, S., Thapper, A. and Messinger, J. (2015) *Energy & Environmental Science*, **8**, 2492-2503
5. Daniel, Q., Huang, P., Fan, T., Duan, L., Wang, Y., Duan, L., Li, F., Rinkevicius, Z., Mamedov, F., Ahlquist, M.S.G., Styring, S. & Sun, L. (2017) *Coordination Chemistry Reviews*, **346**, 206-215
6. Raleiras, P., Khanna, N., Miranda, H.H., Mészáros, L., Krassen, H., Battchikova, N., Aro, E.-M., Magnuson, A., Lindblad, P. & Styring, S. (2016) *Energy & Environmental Science*, **9**, 581-594