Rare-Earth Magnetic Control of Photolysis Reactions

*Muhammad Abdullah, Siyoung Sung, Anthony Campanella, Joseph M. Zadrozny**
Colorado State University, Fort Collins, CO 80523, United States
joe.zadrozny@colostate.edu

Rare-earth elements are essential in modern technology. Yet, their chemical separations and purification is a complicated procedure because the typical thermodynamic quantities (e.g. solubility or ionic radius) vary only gradually, producing inefficient separations processes. Magnetic properties, in contrast, vary starkly across the rare-earth elements, and developing means of harnessing magnetism to separate them is of prime importance.

In this talk, we will cover our approach to harnessing the electronic spin of the rare-earths for a reactive separations procedure that exploits a magnetic effect on radical-pair reactions[1] for the separations handle. Turro and coworkers, as well as Sakaguchi, showed three decades ago that rare earths can modify the outcomes of chemical reactions that incorporate these radical pairs.[2,3] Yet the exact magnetic parameters responsible for that control e.g. spin ground state, bulk magnetic moment, or spin relaxation time, among others, are still undefined.

We are currently designing ligand shells to both provide that understanding and enable tests of chemical separations. We are specifically targeting predominantly O- and N-atom donor chelate backbones, with radical-pair forming groups appended to them. As an initial proof of concept, we are studying the role that magnetic rare earths play in governing the photolysis of benzyl esters, specifically benzylglycine, which will comprise the radical-pair forming groups we eventually append to the ligand scaffolds (**Fig. 1**). Results in this area will be discussed.

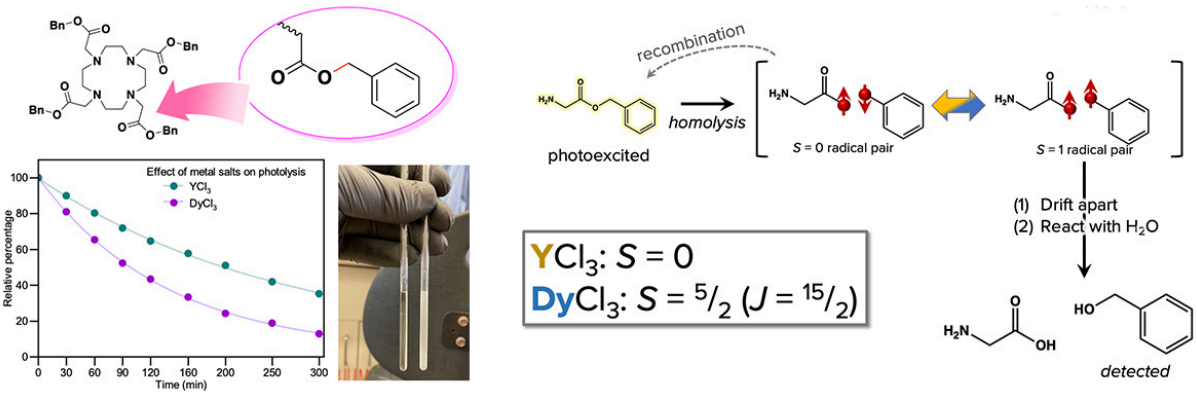

Fig. 1. Summary of results, target chemical system, and spin catalysis.

References.

[1] Steiner U. *et. al.*, *Chem. Rev.* **89**, 51 (1989)
[2] Turro N. *et. al., Chem. Phys. Lett.* **120**, 397 (1985)
[3] Sakaguchi, Y. *et. al.*, *Chem. Phys. Lett.* **106**, 420 (1984)
[4] Buchachenko, A. *et. al., Chem. Rev.* **102**, 603 (2002)