Molecular Recognition in Regioselective Oxygenation of Saturated C-H bonds by a Dimanganese Catalyst

Siddhartha Das, Gary W. Brudvig, Robert H. Crabtree

Department of Chemistry, Yale University

In nature, enzymes (e.g. monooxygenases, fatty acid desaturases etc) are known to catalyze the oxidation (mostly hydroxylation) or dehydrogenation of saturated hydrocarbons, regio- and stereoselectively. Regioselectivity is also of great importance in synthetic and medicinal chemistry and remains a challenge to the chemists. Although a number of examples of porphyrin based transition metal catalysts[1] are known to catalyze regioselective oxidation of C-H bonds, their non-porphyrin counterparts are rare. Some non-porphyrin based catalysts have been reported which can achieve regioselective oxidation, but in all cases the catalyst was covalently attached to the substrates thus preventing multiple turnovers.[2] Here we report a non-porphyrin di-μ-oxo dimanganese catalyst which binds a substrate via non-covalent interaction and can act as a multiple turnover catalyst for highly regioselective oxygenation of saturated C-H bonds.

As previous work by Brudvig, Crabtree and coworkers showed that a (terpy)$\mathrm{Mn^{III}(\mu\text{-}O)_2Mn^{IV}}$(terpy) catalyst is very active as an oxidation catalyst,[3] in the present work the same active site has been maintained. We have now modified terpy with a free carboxylic acid group directed towards the active site and found that this free carboxylic acid group can anchor a carboxylic acid substrate modifying the usual selectivity for oxidation. The C-H bond that is selectively oxidized in this way is located close to the active site in the catalyst and we thus have a molecular recognition effect.

References:

(1) (a) Groves and coworkers, *J. Am. Chem. Soc.*, **1987**, *109*, 5045; b) Breslow and coworkers, *J. Org. Chem.*, **2002**, *67*, 5057; c) Breslow et al., *Proc. Natl. Acad. Sci. USA*, **1997**, *94*, 11156

(2) (a) Sames and coworkers, *Angew Chem. Int. Ed.*, **2000**, *39*, 1618; b) Grieco and coworkers, *J. Am. Chem. Soc.*, **1993**, *115*, 11648; c) Schönecker et al., *Angew Chem. Int. Ed.*, **2003**, *42*, 3240

(3) Brudvig, Crabtree and coworkers, *Science*, **1999**, *283*, 1524