HIGHLANDS IN CHEMISTRY SEMINAR SERIES

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ZOOM

FACULTY HOST:
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"Spectroscopy and Structures of LPMOs: Copper Oxygenases that Oxidize Cellulose"

LPMOs are recently discovered enzymes that catalyse the oxidative cleavage of cellulose. LPMOs has transformed our understanding of biomass degradation, and—moreover—are now critical components in the enzymatic breakdown of biomass in the second generation bioethanol industry.[1]

Our recent work on LPMOs has examined the action of hydrogen peroxide on the enzyme which has been shown to enhance the activity of the enzymes on saccharidic substrates, but also lead to rapid inactivation of the enzyme, presumably through protein oxidation.[2]

In this talk, in addition to a description of the structure and reactivity of LPMOs, I will show that the use of UV/vis, CD, XAS, EPR, MCD, MS and resonance Raman spectroscopies augmented with DFT calculations, reveals that one of the products of protein oxidation in an AA9 LPMO is a long-lived ground-state singlet Cu(II)-tyrosyl species, which is inactive for the oxidation of saccharidic substrates. The formation of the stable Cu(II)-tyrosyl species requires the presence of a water molecule in the axial position of the copper coordination sphere, which then allows the $d(x^2\text{-}y^2)$ SOMO to rotate towards the tyrosyl to form a short Cu-(OTyr) bond. The water molecule is only present in substrate-free conditions, meaning that the binding of substrate prevents Cu(II)-tyrosyl formation and thus protein inactivation during coupled catalytic turnover.

References

[1] K.E.H. Frandsen, P. H. Walton et al, *Nature Chem. Biol.* **2016**, 298—303.
[2] A. Paradisi, P. H. Walton et al, *J. Am. Chem. Soc.* **2019**, 18585—18599.

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