UniSysCat-Colloquium

Dr. Jan Michael Schuller

Department of Chemistry; Universität Marburg

Start Time: Wednesday, July 3, 2024 05:15 pm

End Time: Wednesday, July 3, 2024 06:30 pm

C264
or via Zoom

Dissecting the Wood-Ljungdahl Pathway - Molecular Basis of Metalloprotein Catalysis

Dr. Jan Michael Schuller

Department of Chemistry; Universität Marburg

Research in our laboratory is focused on unravelling the diverse and ingenious mechanisms that nature has evolved to capture and utilise the greenhouse gas CO_2 for biochemical processes. Among the often overlooked heroes of CO_2 fixation, with significant ecological and biotechnological importance, are anaerobic bacteria and archaea. In recent years, our research has focused on exploring the key molecular machinery involved in acetogenesisand methanogenesis. Using redox-controlled cryo-EM, we have uncovered common principles in lifestyles, highlighting the central role of enzymatically decorated nanowires, redox-induced conformational changes and the role metalloproteins play for the catalysis that enables them to sustain at the thermodynamic limit of life.

A key enzyme in methanogenesis is Methyl-coenzyme M reductase (MCR), responsible for nearly all biologically produced methane. Its active site contains coenzyme F430, a porphyrin-based cofactor with a central nickel ion that functions exclusively in the Ni(I) state. The mechanism by which methanogenic archaea achieve the reductive activation of F430 remains a significant gap in our understanding of one of nature's most ancient bioenergetic systems. We have solved the high-resolution cryo-EM structure of the MCR activation complex. Within the activation complex, we discovered three complex iron-sulfur (FeS) clusters similar in structure to the L-cluster, a key intermediate in the biosynthesis of nitrogenase. These complex FeS clusters form an electron transfer pathway to the F430 site and may transfer low-potential electrons to reduce the nickel ion to the active Ni(I) state. Our findings provide unprecedented

insights into the activation mechanism of MCR and offer new perspectives on the early evolution of nitrogenase.

Dr. Sven T. Stripp

Organizer