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#ICMolTalks

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Assembly Hall

Nanozymes based on metal-oxo clusters: from discrete species to extended materials

Abstract

Nanomaterials with enzyme-like characteristics (aka nanozymes) have gained increasing attention as potential enzyme mimics due to their stability and unique physicochemical properties which provide great opportunities for a rational design of catalysts. During the past decade, our group has intensively studied water soluble polyoxometalates (POMs) as artificial metallopeptidases. POMs are a large class of anionic metal oxo clusters typically formed by early transition metals in their highest oxidation state, and we have shown that they can be rendered reactive by imbedding Lewis acid metal ions such as Zr(IV) or Hf(IV) in their structures, resulting in efficient catalysts for the hydrolytic cleavage of peptide bonds in a range of proteins. More recently we discovered that Zr-based metal-organic frameworks (Zr-MOFs), also possess a remarkable peptidase activity, which by far surpassed the most active metal-POM catalysts. These MOFs were also able to selectively hydrolyze peptide bonds in more complex substrates such as proteins. In addition, UiO-66 Zr-MOF has been found to effectively catalyze intramolecular and intermolecular peptide bond formation without any signs of epimerization using ethanol as a solvent, a desired but uncommon green biomass-derived solvent. Ultimately, these findings indicate that materials based on Zr(IV)- and Hf(IV)-oxo clusters have a large potential to be developed as a novel class of nanozymes for peptide bond formation and hydrolysis.

Key References:

[1] Ly, H.G.T. et.al. J. Am. Chem. Soc. 2018 140 , 6325 [2] Moons, et.al . Angew. Chem. Int. Ed. 2020 , 59 , [4] de Azambuja, F.; et.al ACS Catal. 2021, 11, 271. [5] de Azambuja F., et.al Acc. Chem. Res. Res., 2021 , 54 , [6] de Azambuja, F.; ACS Catal 2021 11 7647. [7] Wang, S. et.al. Nat. Commun 2022 13 1284 [S. A. M. Abdelhameed, et.al. Nat. Commun 2023 , 14, 486

Biography

Tatjana N. Parac-Vogt is a full professor and head of the laboratory of bioinorganic chemistry at KU Leuven, where she is pursuing interdisciplinary research at the interface of inorganic chemistry, biochemistry, materials science, and catalysis. Her main research lines are the development of metal cluster-based complexes and materials such as polyoxometalates (POMs) and metal-organic frameworks (MOFs) for biologically inspired reactivity with biomolecules and model systems. The group is also creating new hybrid structures based on polyoxometalates using principles of supramolecular chemistry and biomolecular recognition. Tatjana is the recipient of IUPAC 2023 Distinguished Women in Chemistry and Chemical Engineering award. She is a Fellow of the Royal Society of Chemistry and has been elected as a Chemistry Europe Fellow (Class 2020/2021), the highest award given by an association of European Chemical Societies. Tatjana is a member of AcademiaNet, a global portal of outstanding female scientists, and she is currently the Vice-President of the European Rare-Earth and Actinide Society. Tatjana serves on the Editorial Board of Chemical Society Reviews and is a member of the Advisory Board of Inorganic Chemistry. She is also a member of the Editorial Board of Inorganics, and of “Chimie Nouvelle” magazine of the Société Royale de Chimie.