Polyoxometalates as Inorganic Amino Acids for Biomedical Applications

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Introduction & Objective

- Polyoxometalates (POMs) encompass an enormous class of polynuclear oxo-bridged early transition metal compounds with rich topology, versatile chemical and physical properties.
- This research comprises the study of heteropolyanion POMs ([X\textsubscript{m}M\textsubscript{q}O\textsubscript{m+n}])\textsuperscript{n−}, X = heteroatoms, more specifically the additionally complexed cations, e.g. first-row transition metals.
- The Anderson POM (APOM) comprises six edge-sharing Mo\textsubscript{6} (MoO\textsubscript{3} or WO\textsubscript{3}) octahedra enclosing a central, edge-sharing heteroatom of octahedral geometry XO\textsubscript{6} leading to a planar arrangement [1].
- New research areas in biology are highlighted since it is becoming one of the go-to POMs for biological applications based on recent results in macromolecular crystallography, tumor inhibiting, antibacterial and antiviral studies [2].
- Ability to graft particular organic moieties allows to produce hybrid POMs with specific functionalities and thus expanding their applicability [3].

Results & Discussion

- APOMs were first grafted simply with tris(hydroxymethyl)aminomethane, yielding the single and double sided compounds respectively (C\textsubscript{3}H\textsubscript{9}NO\textsubscript{3})\textsubscript{6} [Cr(OH)\textsubscript{18} (OCH\textsubscript{2}) \textsubscript{3}CNH\textsubscript{2}] \textsubscript{12}H\textsubscript{2}O and [Ni(C\textsubscript{3}H\textsubscript{9}NO\textsubscript{2})\textsubscript{6}MnMo\textsubscript{18} (OCH\textsubscript{2}) \textsubscript{3}CNH\textsubscript{2}] \textsubscript{2}]. Afterwards they were manipulated to form activated esters (e.g. (C\textsubscript{3}H\textsubscript{9}NO\textsubscript{2})\textsubscript{6}MnMo\textsubscript{18} (C\textsubscript{3}H\textsubscript{9}N\textsubscript{2}O\textsubscript{4})\textsubscript{6}]) through the formation of amide bonds, termed post-functionalization and to be conjugated by coupling to a L-D-Phe peptide.
- The other part of the study examines the grafting of a tris-ligand bearing a chloride functionality, (C\textsubscript{3}H\textsubscript{9}N\textsubscript{2})\textsubscript{6}MnMo\textsubscript{18} (OCH\textsubscript{2}) \textsubscript{3}CNCl\textsubscript{3}] \textsubscript{4} in a pre-functionalized manner towards an S\textsubscript{2} reaction with glutathione. Finally, the latter was transformed to bear the organic azide handle (C\textsubscript{3}H\textsubscript{9}N\textsubscript{2})\textsubscript{6}MnMo\textsubscript{18} (OCH\textsubscript{2}) \textsubscript{3}CN\textsubscript{3}]- envisaging a click reaction with a biological relevant peptide, e.g. tat-peptide.

Conclusion & Outlook

- A variety of hybrid POMs was prepared containing different types of organic handles in successful bio-conjugation reactions.
- Bio-conjugation with a tat-peptide will be tested.
- Biomedical testing will be performed to potentially unravel the bio-activity of these compounds.

References