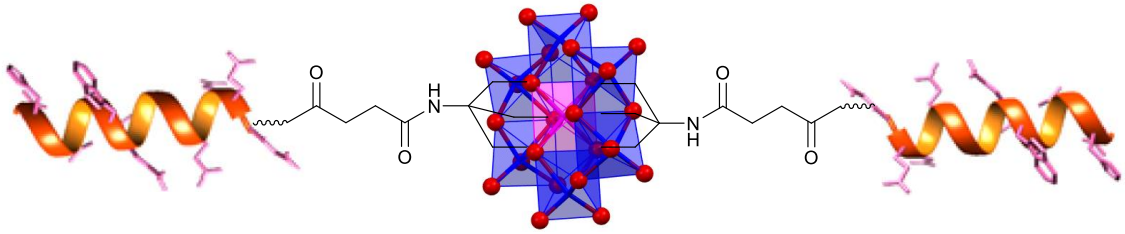
Design of bio-hybrid polyoxometalates (POMs) with pharmacological activity

Polyoxometalates (POMs) are molecular metal oxides of early series transition metals as Mo, W, V in their highest oxidation state. POMs have a large structural topology and a rich versatility of chemical and physical properties. The POMs, indeed, find application in catalysis, materials science and as potential nano drugs, since they display antiviral, antibacterial, neuroprotective and anticancer activity. Their biological activity is mainly due to the alteration of the redox processes of the cell and to the ability to interact with biological macromolecules (proteins and enzymes) containing cationic groups. A limit to their use is the low selectivity; for this reason, **studies are underway to functionalize these compounds with biomolecules**, **in order to make POMs more selective.**

The project therefore plans to study the interaction between POM and biological targets, and to optimize the preparation of bio-inorganic hybrid derivatives. In particular, the following steps are under study:
(i) the covalent functionalization of molybdates and vanadates featuring antitumor activity, with peptides and other bio-molecules (Sugars, vitamins, PNA) suitable for molecular recognition of biochemical targets;
(ii) recognition of peptides and proteins involved in diseases such as cancer and Alzheimer's disease, to highlight the inhibitory abilities of polyoxotungstates;
(iii) the preparation of delivery systems (capsules and nanotubes).



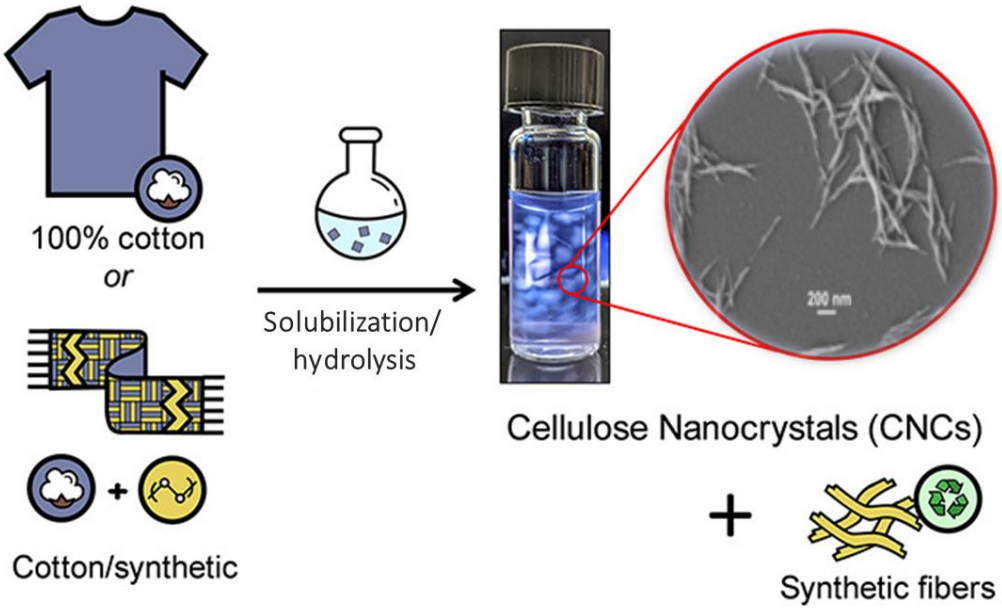
$[MnMo_6O_{18}\{(OCH_2)_3CNH_2\}_2]^{3-}$ bis-conjugated with a peptide

The planned work consists in the synthesis of hybrid derivatives (NMR characterization, ESI-MS, optical spectroscopies) and in the study of interactions with proteins (UV-vis, CD, Fluorimetry, 2D NMR). The proposal involves collaborations in the field of synthesis and characterization of peptides or proteins. The implementation of cytotoxicity tests at other institutions is also planned.

Funding: PRIN 2022CAS9ZT Development of HYbrid and Multifunctional Bio-conjugates against Alzheimer’s Disease (HYMBAD)

Circular chemistry: catalytic valorization of waste materials

The Italian industry is now facing the challenge of Circular Economy. In particular, the **textiles** represent an urgent problem in terms of disposal and recycling, due to the *fast fashion* trend, which is related to the production of huge amount of post-consumer textiles.
The project is aimed at discovering **new strategies for the separation** of valuable materials form different types of textiles, including cotton or mixed fabrics. While **catalytic depolymerization** will be investigated to release monomers of synthetic polymers, **deep eutectic solvents (DES)** will be used as alternative, green solvents, to recover cotton fibers, in order to allow their recycling into clothing production chain, or for different applications. In this latter case, the isolated fibers will be modified and hybridized to enable their integration into surfaces or to become scaffolds for active agents (e.g. antibacterial or catalytic nanoparticles).



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