

# **Tailoring functionality of clusters and their complexes with biomolecules by size, structures and lasers**

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Clusters have the potential to be used in creation of tailored materials with desirable optical and reactivity properties. Therefore, the following topics will be addressed and illustrated on selected examples:

- Stoichiometric zirconium oxide cations are potential building blocks for a cluster assembled catalyst with high oxidation activity. We have identified a series of clusters with a radical oxygen center that exhibit enhanced activity and selectivity for three oxidation reactions of widespread chemical importance. These species may promote multiple cycles of oxidation reactions and therefore exhibit true catalytic behaviour.
- Metallic cluster-peptide hybrid systems (e.g. Trp-Ag<sub>n</sub><sup>+</sup>, Trp-(Ala)<sub>n</sub>-Ag<sub>n</sub><sup>+</sup>) exhibit unique optical properties such as absorption enhancement and fluorescence which can be tuned by cluster size and the type of hybrid structure. This model systems serve to study the interaction between silver clusters and proteins with the aim to provide basic understanding for developing biosensors and biochips.
- We propose a new “field induced surface hopping” method for the optimal pump-dump control allowing to explore the controllability of dynamics in complex systems. This will be illustrated on Schiff base molecular switches and on laser selective photochemistry in nanoparticle-biomolecular hybrid systems.