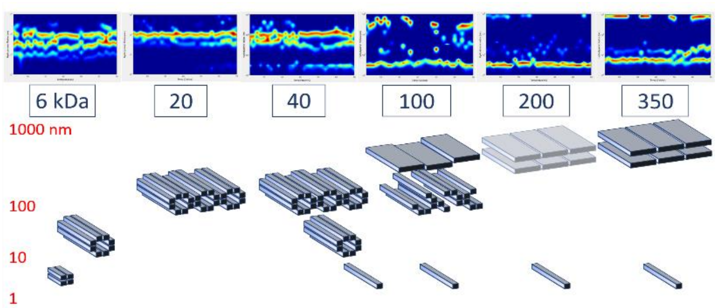
# Biomimicry for green chemistry application – role of confinement

The characterization, development and optimization of novel materials at the nanoscale have open new and revolutionary applications due to their unique physical properties [1]. In particular, biomimetism has shown great promises in the development of sensors, nanocatalysts, green processes for the use of sustainable energy sources. Biomimetism is divided in two main research areas: reproducing structures of biological systems [2] or mimicking its function and physical properties [3]. The first approach often combines biological systems (like enzymes) to artificial systems to take advantage of the high efficiency of the biological system optimized for specific physiological conditions. However, due to the high sensitivity of biological systems to change in their environment, the efficiency of these structures can decrease significantly with small perturbations. The second method developed to mimic the physical properties and enhanced reactivity of biosystems has the distinct advantage of allowing the development of tailored structures stable under various conditions retaining the very high efficiency of their biological counterparts.

The presentation will provide details on the contribution of a specific property common to all systems at the nanoscale: confinement, based on a combination of simulation and experimental characterization methods. To characterize this property, we have developed a series of nanostructures through the self-assembly of amphiphilic copolymers into nanotemplates in aqueous solution. The nanoarchitecture of the template can be controlled to provide 1D (nanotubes) or 2D (nanosheets) confined environment with an internal dimension of 2nm. The characterization of a model reaction within the template has demonstrated that the control of the thermodynamics of reactions in confined environment can give access to synthetic pathways that are not favoured under environmentally friendly conditions in the bulk. This role of confinement in the development of biomimetic nanoreactors as well as the control provided by the dimensionality of the confined space on the reaction itself will be emphasized in the presentation [4]. In addition, the development of biomimetic nanoreactors requires not only the control of the thermodynamics of a reaction but also its kinetics through insertion of catalytic active centers. Therefore, catalytic active centers were synthesized *in situ* taking advantage of the confined environment provided by the nanotemplates, which favored the *in situ* synthesis of metal nanoclusters (Pt and Au) with controlled size and geometry. This precise control of the geometry and size of the active center from 2nm nanoclusters of Pt and Au to an atomically thin and stable Au layer has provided a wide range of catalytic activity accessible for the nanoreactors. The nanoreactors produced with this method are water soluble, unsupported reactors and are stable under various conditions (wide range of pH and temperature). The biomimetic nanoreactors developed in this study offer a new opportunity for organic synthesis in aqueous environment using the control of entropy within confined cavities.



*Fingerprint of the shape of the nanoreactors as function of the molecular weight of the polymer [4].*

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