Super Resolution Imaging of Nanomaterials: Looking at Nanomedicine with New Eyes

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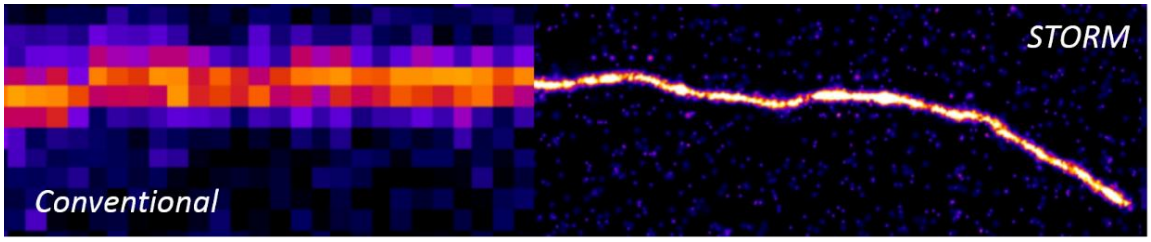
The use of nanocarriers for intracellular delivery of therapeutic moieties is a great challenge for synthetic chemistry and nanotechnology. In this framework, supramolecular materials such as micells, liposomes self-assembled nanoparticles and nanofibers plays a pivotal role. A crucial factor limiting the design of effective materials is the lack of understanding about material-cell interactions that hampers the rational design of nanosized carriers. This is particularly relevant for supramolecular materials as their complex structure poses several unanswered questions.

Here we discuss the use of super resolution microscopy to image materials in vitro and in mammalian cells. This novel technique, allowing to obtain a resolution down to 20nm, had a dramatic impact in the field of cell biology, however its use in the field of chemistry and nanotehcnology is poorly explored. Super resolution microscopy offers nanometric resolution and multicolor ability, therefore it is an ideal tool to study nano-sized supramolecular assemblies of multiple components in vitro and in cells.

We employed Stochastic Optical Reconstruction Microscopy (STORM) to image biomaterials in vitro, with special emphasis on supramolecular polymers and nanoparticles, unveiling novel information on materials structure and dynamics, a key issue of supramolecular materials.



Moreover we propose a methodology to image nano-sized materials in cells, tracking them during their membrane targeting, cell uptake and intracellular targeting. We show how 2-color STORM can be used to perform nanometric-accurate colocalization unveiling at the molecular level materials-cell interactions.

This allow to look at nanomaterials in action with new eyes and use the information obtained for the “STORM-guided” design of novel nanomaterials for drug delivery and other targeted therapies.