Synthesis of Amphiphilic Block Copolymers and their use for the Fabrication of Nanoparticles with potential application as Drug Delivery Systems

Roberto Simonutti
University of Milano Bicocca

Amphiphilic block copolymers with low molecular weight dispersion are driven by thermodynamics into forming precise nanovectors for drug delivery.
The increasingly wide choice of monomers, the improved control on block length and arrangement, the growing understanding of the kinetics pathways of nanoparticle assembly are offering endless opportunities to shape these tools of nanomedicine. Exploration of this potential usually involves production of libraries of copolymers and assembly of batches of nanoparticles.
Full characterization is necessary, since the dependence on bioactivity from shape and size is so extreme that even theoretically biocompatible polyethylene glycol (PEG)-b-polylactide (PLA) systems can assume cytotoxic forms.
Here we present a wide set of polymer nanoparticles obtained varying the total molecular weight of the PEG-b-PLA copolymer, the ratio of the two blocks and the good solvent used for the self-assembly, and we show how dynamic light scattering (DLS) supported by cryoTEM can sort these nanoparticles in a limited number of sets. Thus studies of cytotoxicity can be done on a reduced number of nanoparticles.
In order to increase the bio-compatibility of the nanoparticles it is possible to substitute PEG block with a poly(2-oxazoline) (POX) one, an hydrophilic polymer belonging to the family of the so-called pseudo-polypeptides. Also in the case of these copolymers a large number of samples are synthesized varying the ratio between the hydrophilic and hydrophobic block and used for the fabrication of nanoparticles. The nanoparticles are characterized by DLS, AFM and electron microscopy. A comparison between the self-assembly behaviour of PEO-b-PLA and that of POX-b-PLA will be also discussed.