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Investigation of size, surface charge, PEGylation degree and concentration on the cellular uptake of polymer nanoparticles

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Highlights

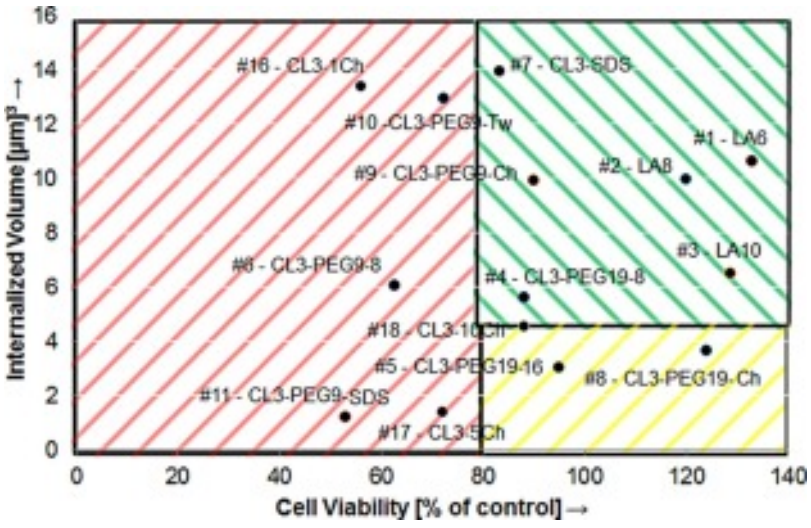
- â€¢ A library constituted of polymer NPs with different characteristics is produced.
- â€¢ Analyses of parameters such as size, concentration, charge, and emulsifier over the uptake are performed.
- â€¢ The NP performance in terms of number, area and volume internalized are simulated.
- â€¢ A criterion to select polymer NPs on the basis of their performance is proposed.

proposed.

Abstract

In this work a large number of polymer nanoparticles (NPs) with different features have been synthesized through emulsion polymerization-based methods. Poly(methyl methacrylate) (PMMA), poly-É›-caprolactone (PCL), and poly(lactic acid) (PLA) based NPs with different size, hydrophobicity, surface charge, PEGylation degree, type of emulsifier and Î¶ potential have been produced and characterized. All the different NPs have been adopted for cellular uptake studies, leading to a precise quantification of the number of internalized NPs into a selected tumor cell line. The experiments summarize, emphasize and improve the comprehension of the influence of NPs features on the uptake efficiency. In detail, a linear relationship between uptake and both size and NP concentration independently upon other NP characteristics was found. Moreover, it was confirmed that cells are able to internalize and retain for a long time preferentially positively charged NPs. Finally, by coupling results of uptake studies with cell viability measurements, an easy and fast check to control the effectiveness of a selected polymer as drug carrier has been proposed. In particular, we observed that biodegradable PLA-based NPs with high molecular weight, non-PEGylated and positively charged PCL NPs are the better choice to maximize the uptake and minimize side effect against cells.

Graphical abstract



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Keywords

Polymer; Nanoparticle; Drug delivery; Endocytosis; Imaging; Uptake

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