Sequential adsorption of charged nanoobjects as a method of formation of drug delivery systems

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The idea of drug targeting, proposed by Paul Ehrlich at the beginning of the twentieth century considered a hypothetical 'magic bullet' consisting of two principal components. The first component should recognize the target and bind to it, while the second component should perform therapeutic action. Polymeric nanocarriers are ideal candidates for use as a 'magic bullet' due to their potential to localize in a specific manner to the site of action and reduce or eliminate the possible side effects. To prepare targeted polymeric nanocarriers, the proper functionalization/surface modification should be performed. The sequential adsorption of oppositely charged nanoobjects (layer by layer (LbL) method) is a powerful technique for the fabrication of multifunctional coatings. The advantages of the LbL method are the ease of manipulation and the multifunctionality that comes from the possibility of modification of the multilayer shell by organic molecules, inorganic nanoparticles, carbon nanotubes, antibodies, lipids, or nanoparticles. That multifunctionality can be utilized for the preparation of targeted drug delivery systems. The polymeric nanocarriers were formulated using a method based on a nanoemulsion template. [1-2]. The polymeric nanocarriers were prepared by the self-emulsification and self-emulsification solvent evaporation methods respectively. Furthermore, polymeric nanocores were functionalized by layer-by-layer method to achieve targeted drug delivery systems. The polymeric nanocarriers with an average size of 80-100 nm were stabilized by an AOT/Polycation surface complex. Such nanocores were encapsulated with multilayer shells formed with biocompatible polyelectrolytes (poly-L-lysine hydrobromide PLL (MW 15000-30000), poly-L-glutamic acid sodium salt PGA (MW 15000-50000)). They were further modified for passive targeting by pegylation (adsorption of pegylated polyelectrolyte PGA-g-PEG as an external layer), for active targeting by immobilization of selected antibodies, whereas for magnetic targeting by iron oxide nanoparticles incorporation into a multilayered shell. The polymeric nanocarriers were also tested as a theranostic system i.e. the MRI-detectable drug delivery system. The developed systems may be considered as promising platforms for future nanomedicine.

References

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