ADVANCES IN ENGINEERING NOVEL MATERIALS FOR NANOMEDICINE

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Pharmaceutical nanocarriers, including liposomes and polymeric micelles, are frequently used for the delivery of a broad variety of both soluble and poorly soluble pharmaceuticals to enhance the *in vivo* efficiency of many drugs. Now, within the frame of this concept, it is tempting to develop multifunctional stimuli-responsive nanocarriers, i.e. nanocarriers that, depending on the particular requirements, can circulate long; target the site of the disease via both non-specific and/or specific mechanisms, such as enhanced permeability and retention effect (EPR) and ligand(antibody)-mediated recognition; respond local stimuli characteristic of the pathological site by, for example, releasing an entrapped drug or deleting a protective coating facilitating thus the contact between drug-loaded nanocarriers and target cells (especially important for cancer therapy); and even provide an enhanced intracellular delivery of an entrapped drug with its subsequent delivery to specific intracellular organelles, such as nuclei, lysosomes or mitochondria. Such carriers can be additionally supplemented with reporter moieties to follow their real-time biodistribution and target accumulation. Among new developments to be considered in the area of multifunctional pharmaceutical nanocarriers are: drug- or/and RNA-loaded delivery systems additionally decorated with cell-penetrating peptides for the enhanced intracellular delivery; “smart” multifunctional drug delivery systems, which can reveal/expose temporarily hidden functions under the action of certain local stimuli characteristic for the pathological zone (such as lowered pH, redox-conditions, hypoxia, or locally increased expression of certain enzymes); new means for controlled delivery and release of siRNA; approaches for intracellular drug delivery and organelle targeting; and application of nanocarriers co-loaded with siRNA and drugs to treat multidrug resistant tumors.