BIOLOGICAL APPLICATIONS OF COLLOIDAL NANOPARTICLES

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Two ideas for applications in which colloidal nanoparticles are used to interface cells are discussed. For this the report will be structured in three parts. In the first part the colloidal nanoparticles and in particular their surface chemistry will be discussed. In the second part a nanoparticles based FRET system for the detection of intracellular ions will be reported. In the third part an alternative system for the detection of intracellular ions based on polymer capsules / nanoparticles based will be described

With a very general procedure inorganic hydrophobic nanoparticles of different materials can be transferred into aqueous solution by coating them with an amphiphilic polymer that is based on a poly(maleic anhydride) backbone modified with alkylamine sidechains. Functional groups with an amino anchor can be directly introduced in the polymer by reacting them to anhydride groups of the backbone. This offers a very general route to water-soluble nanoparticles of high colloidal stability, with good size distribution, and with a variety of functional groups that are directly embedded in the polymer shell without the need of post-bioconjugation.

A FRET-pair based on colloidal quantum-dot donors and multiple organic fluorophores as acceptors is reported. In contrast to similar systems which are used as biosensors and detect specific changes of the donor/acceptor-distance under the influence of analyte binding, our nanoparticle design seeks to optimize sensors that detect spectral changes of the acceptor at fixed donor/acceptor distance. This approach allows for relatively small acceptor-donor distances, and thus for high energy transfer efficiencies, while simultaneously permitting high colloidal stability. The photophysics of the system is characterized and compared to similar systems which have been reported in literature.

Polyelectrolyte microcapsules have been loaded with a pH sensitive, high molecular weight SNARF-1-dextran conjugate. SNARF-1 exhibits a significant pH-dependent emission shift from green to red fluorescence under acidic and basic conditions, respectively. The spectral properties of the dye were found to be largely retained after the encapsulation. Upon ingestion of SNARF-1-filled capsules by breast cancer cells or fibroblasts, the pH change of the local capsule environment during transition from the alkaline cell medium to the acidic endosomal/lysosomal compartments could be observed. By incorporating magnetic and fluorescent colloidal nanoparticles into the capsule-shell a novel type of multiplexed sensor system was developed.