CONTINUOUS FLOW PHASE TRANSFER OF HYDROPHOBIC NANOPARTICLES

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Abstract

To improve the early stage diagnostic of widespread diseases like cancer or diabetes highly sensitive and specific imaging tools are needed. Preliminary concepts often used organic dies functionalised with bioactive affinity molecules. One major drawback of this approach is caused by the low stability of these molecules. In contrast inorganic nanoparticles (NPs) like quantum dots exhibit a strong fluorescence with low photo bleaching effects.

To profit from these advantages water-soluble NPs are needed. The solubility of NPs is determined by the surrounding shell of organic molecules. An exchange of these ligands causes a change in the solubility. In addition, ligands also protect the particles for uncontrolled aggregation and chemical reaction with the surrounding media, e.g. oxidation.

Here we will present a two step concept for phase transfer of NPs soluble in non-polar media. The first step is an exchange of the stabilizing organic molecules against a multidental binding short chain polymer. In a second step the modified NPs are encapsulated in block-copolymer micelles and transferred into an aqueous solution. Finally we close the micelle shell by cross linking the polymer chains to ensure a good separation of NPs and surrounding media.

The encapsulation is performed by using micro fluidic components in a continuous flow phase transfer approach to guarantee best reproducibility and up-scaling capacity. In addition, the opportunity of using block-copolymers with different end-groups gives us the possibility to functionalize our micelles with affinity molecules like antibodies.

This encapsulation procedure can be used for different kinds of nanoparticles without changing the interaction between the outer shell of the capsule and the surrounding. Beside the well-known quantum dots and iron oxide particles we have also encapsulated novel nanoparticle systems like CdSe/CdS dotrods with quantum yields above 60% and PbS particles with strong emission in the IR. This makes our system ideal for cross evaluation of novel methods like MPI.

Keywords: nanoparticles, phase transfer, water solubility, microfluidic

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