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Intracellular Behaviour of Nanoparticles Based on Their Physicochemical Properties

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Extended Abstract

Nanoparticles (NPs) offer a wide array of biomedical applications ranging from drug-delivery and optical imaging contrast agents to cancer and gene therapies. Successful applications of NPs rest on their optimized delivery at single cell level. Hence, it is important to understand how the size, shape, and surface properties (physicochemical properties) of NPs affect their uptake and transport properties for improving the interface between nanotechnology and biology. The physicochemical properties of NPs affect their uptake, transport, and removal pathways. Gold nanoparticles are used as a model system in this regard since their physicochemical properties can be easily manipulated. For example, gold nanoparticles can be made in different sizes and shapes, and their surface can be easily modified with targeting ligands. Once in the cell via receptor mediated endocytosis (RME) at the cell membrane, majority of NPs are trafficked via an endo-lysosomal pathway. Within the size range of 2-100 nm, gold nanospheres or spherical nanoparticles (GNPs) of diameter 50 nm demonstrate the highest uptake. Cellular uptake studies of gold nanorods (GNRs) show that there is a decrease in uptake as the aspect ratio of GNRs increases. Theoretical models support the size and shape dependent NP-uptake. The surface ligand and charge of NPs play a bigger role in their uptake, transport, and organelle distribution. Exocytosis of NPs is dependent on size and shape as well; however, the trend is different compared to endocytosis.