Department of Materials Science and Engineering

Ph.D. Candidacy Exam

05/05/2020 3:00pm-5:00pm
Online (Zoom)
Zoom link: https://drexel.zoom.us/j/91059483344

Long Circulation Nanoparticles

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With the rapid development of nanotechnology, nanomaterials have been widely utilized in biomedical applications. Nanoparticles can be used as delivery cargoes of drug or therapeutic agents, imaging or detection tools etc. However, nanoparticles administrated into physiological environment can be cleared out by reticuloendothelial system (RES) quickly due to the formation of protein corona. Fast clearance of nanoparticles reduces their therapeutic efficacy, imaging sensitivities and desired accumulation at target tissues. The abnormal biodistribution of these nanoparticles in immune organs also can cause toxic side effects. During the past several decades, multiple approaches have been developed to prolong the nanoparticles blood circulation time, reduce their clearance by immune system, and enhance their accumulation at target sites. Poly(ethylene glycol) (PEG) polymer,, zwitterionic polymer graft and cell membrane coating are the major platforms. PEGylation is the generation of flexible PEG chains on the surfaces of nanoparticles. PEG can prevent the formation of protein corona by steric repulsion. The effect of PEG chains length, density, optimum structure design will be reviewed. The reveal of accelerated blood clearance (ABC) phenomenon after repeated injection of PEGylated nanoparticles limit its further development. Zwitterionic polymer, which contain positively and negatively charged moieties along the polymer chain, resists protein absorption by the formation of a water barrier through electrostatic attraction. The abundant functional groups and low immunogenicity induction make zwitterionic polymer an ideal replacement of PEGylation. To improve the biocompatibility of nanoparticles while maintain a long blood circulation time, cell membrane coating had also been studied. The cell membrane can camouflage nanoparticles since they bare the 'self' peptide that can evade the macrophage uptake. Cell membrane coating with different cell membranes and concerns about this approach will be presented. The perspectives of fabricating long circulation nanoparticles will also be discussed.