Amgen Seminar Series in Chemical Engineering

in

Cherry Auditorium, Kirk Hall, 1 PM

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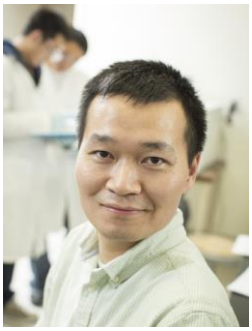
Lipid/inorganic hybrids: biointerfaces and drug delivery applications

By



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Zwitterionic phosphocholine (PC) lipids are the major component of the outer membrane of mammalian cells. While PC lipids are anti-fouling (resistant to protein adsorption), they adsorb all tested inorganic nanoparticles. It is well-established that PC liposomes adsorb silica nanoparticles followed by membrane fusion onto the particle surface. However, PC liposomes are only adsorbed by titania and other metal oxides (e.g. iron oxide) without fusion. We found that the lipid phosphate group is mainly responsible for bonding to these non-silica oxides, while the choline in the headgroup poses a steric effect, preventing subsequent liposome fusion. By flipping the PC headgroup to choline phosphate (CP), where the phosphate is fully exposed, liposome fusion on titania was achieved. The second class of material we studied was metal, and gold nanoparticles (AuNPs) are used as an example here. Citrate-capped AuNPs are adsorbed very strongly via van der Waals force by PC liposomes, inducing a phase transition temperature increase and local lipid gelation. The consequence of this gelation is a transient liposome leakage upon AuNP adsorption or desorption. Finally, all the carbon-based nanomaterials (graphene oxides, carbon nanotubes, and nanodiamond) are adsorbed by PC liposomes mainly via hydrogen bonding. The above three types of nanoparticles (metals, metal oxides, and carbon) have covered the most important and representative inorganic materials. While they all interact strongly with PC liposomes, each type has its own interaction mechanism. These inorganic/lipid hybrids are useful for analytical and biomedical applications. For example, we have also demonstrated that all these conjugates can be internalized by cancer cells while the free PC liposomes cannot. Controlled content release from liposomes was also achieved based on our fundamental understandings.

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