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Unimolecular nanoparticles for targeted drug delivery

Drug nanocarriers have received increased attention because they can greatly enhance the therapeutic efficacies of drug payloads. Conventional polymer micelles, formed by the self-assembly of multiple linear block copolymers, are one of the most widely studied drug nanocarriers. However, one major concern with these conventional polymer micelles is their poor *in vivo* stability due to the dynamic nature of the self-assembly process. Premature rupture of these drug nanocarriers during circulation can cause a burst release of payloads into the bloodstream, which can lead to potential systemic toxicity and surrender their targeting and/or imaging abilities, thereby largely limiting their *in vivo* applications. Unimolecular micelles formed by single/individual multi-arm star amphiphilic block copolymers have been investigated to overcome this drawback. Because of their covalent nature and unique chemical structure, properly engineered unimolecular micelles can possess excellent *in vivo* stability. Moreover, due to their excellent chemical versatility, these unique unimolecular micelles can be tailored with different targeting ligands (e.g., small molecules, peptides, antibodies, nanobodies or aptamers) and/or imaging probes (e.g., fluorophores, radioisotopes or MRI contrast agents) to achieve multifunctionality. We have successfully developed a series of multifunctional unimolecular micelle platforms for targeted cancer (e.g., breast cancer and neuroendocrine cancer) theranostics. We have also engineered unique unimolecular micelles to treat glaucoma as well as vascular diseases (e.g., intimal hyperplasia attenuation) in a targeted manner. Moreover, other than small drug molecules, siRNA, peptides and small proteins have also been successfully delivered via unimolecular nanoparticles through electrostatic interactions. In summary, unimolecular nanoparticles are a promising drug nanocarrier that warrants further investigation for a broader range of potential applications.

Biography

Shaoqin Sarah Gong is a Vilas Distinguished Achievement Professor in the Department of Biomedical Engineering and the Wisconsin Institute for Discovery at the University of Wisconsin-Madison. Her research group has developed a series of multifunctional drug/agent nanocarriers including unimolecular micelles, polymer nanocapsules, polymer vesicles and polymer-functionalized inorganic nanoparticles for targeted drug/agent delivery to treat and monitor various major health threats including cancers, vascular disorders and eye diseases. She has co-authored over 140 peer-reviewed journal articles and more than 130 conference papers. She is an Editorial Board Member for several journals *including Biomaterials, Theranostics, Biofabrication* and *Nanotheranostics*. She also serves as an Associate Editor for Biomaterials and is the winner of several awards including the NSF CAREER Award and NIH Career Development Award.

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