Abstract: The RNA interference and the clustered regularly interspaced short palindromic repeats associated protein 9 (CRISPR/Cas9) system have emerged as the most promising tools for gene therapy. Although the development of effective viral vectors put gene therapy on the road to commercialization, nonviral vectors show promise for practical use because of their relative safety and multifunction. Rapid advances in nanotechnology have brought exciting novel opportunities for the development of non-viral gene carriers. Herein we designed various multifunctional nanocarriers for siRNA and CRISPR/Cas9 delivery and systematically evaluated their therapeutic efficiency in precise gene therapy for cancer and dyslipidemia. Our research showed rational design of nanoparticles by tuning their physicochemical properties can enable the active targeted delivery of nucleic acids to tumor/liver cells to achieve multiplex gene disruption, gene insertion, gene silencing, and gene activation in vitro and in vivo. Encouraged by the good performance of nanoparticle-based gene therapy, we devoted to understanding the critical factors influencing in vitro/in vivo fate of nanomedicines. After comprehensively investigating the influence of surface charge of nanoparticles on the pharmacokinetics, tumor accumulation, tumor penetration, cell internalization, and biomacromolecule binding, we demonstrated that cationic nanoparticles exhibited superior tumor penetration and antitumor efficacy in five different tumor models and were enabled to scavenge pro-inflammatory molecules for anti-metastasis therapy.

Bio: Dr. Hong-Xia Wang is currently an associate research scientist in the Department of Biomedical Engineering at Columbia University. Dr. Wang completed her Ph.D. study in the University of Science and Technology of China in 2014 and joined Dr. Kam Leong’s lab as a postdoctoral scientist at Columbia University in 2015. In 2018, she was promoted to be an associate research scientist. Dr. Kam Leong is a member of the USA National Academy of Engineering and the Editor-in-Chief of *Biomaterials*. Dr. Wang’s research focuses on developing innovative nanomedicines based on drug delivery, siRNA delivery, genome editing, and cell-free DNA scavenging for cancer/dyslipidemia therapy. Dr. Wang’s research work has been published in journals including *Chemical Reviews, PNAS, Advanced Materials, Nano Today, ACS Nano, Biomaterials*, and *Journal of Controlled Release*. She won “Young Scientist
“Award” in 9th World Biomaterials Congress, “The First Prize of GE Foundation TECH AWARD”, and “First Annual GDGE FG PostDoc Award” at the 2018 CRS Annual Meeting.