Summary

Because of their functions and roles in diseases, harnessing the powers of macrophages – a type of immune cell – for therapeutic purposes, such as treating cancers, is highly attractive. However, molecules serving as instructions to tailor macrophage behavior must often be inside the cells to perform their tasks. Facilitating this is challenging, spurring the development of capable technologies. In light of this, this PhD focused on one such up-and-coming technology: photoporation. Here, very small particles – nanoparticles *e.g.*, biocompatible polydopamine nanoparticles (PDNPs) – are brought into contact with cells, which are then irradiated with a laser. This causes the nanoparticles to heat up and generate openings in the cell membrane through which molecules can then enter the cells. Throughout the thesis, we illustrated an efficient way of finding optimal photoporation parameters and proved the applicability of PDNP-sensitized photoporation for the delivery of molecules into macrophages without disturbing their normal behavior. Finally, we demonstrated an approach to enhance the delivery of functional molecules by releasing naturally taken up molecules – coated on light-sensitive nanoparticles – from their intracellular cage using a laser treatment. Overall, this work provides insights instrumental to further streamline and improve photoporation as an intracellular delivery method towards highly efficacious macrophage-based therapies.