Abstract

The study of polymer-protein nanoparticles is of increasing interest due to their various potential applications in biological and catalytic areas. Synthetic polymers can be tailored with different functionalities to impart proteins with additional features and enhanced biological performance. In this dissertation work, we were mainly focusing on the preparation of polymer-protein core-shell nanoparticles (CSNPs) by synthesizing novel polymers and assembling them with proteins for specialized applications.

In the first part of the research, a pyridine grafted diblock copolymer P(CL-g-Py)-b-PCL was prepared through ROP and CuAAC reactions. CSNPs from the self-assembly of this polymer and transferrin (Tf) were characterized by dynamic light scattering, transmission electron microscope and circular dichroism. As compared with CSNPs prepared from homopolymer P4VP and Tf, these particles exhibited narrower size distribution, improved particle stability, and higher loading capacity for anticancer drug doxorubicin (DOX). Additionally, the drug loaded Tf/P(CL-g-Py)-b-PCL CSNPs can effectively target MCF7 cancer cells via the binding of Tf to Tf receptors. In another study, block copolymer PS-b-PSMA was prepared through one-pot RAFT polymerization and modified with NTA moieties. The self-assembly of the polymer in the presence of Ni^{2+} ions led to the formation of nanoparticles of about 20 nm in aqueous solution. The NTANi complexes located on the particle surface can capture 6×His-tagged proteins by strong affinity binding. The conjugated proteins are orientally immobilized within close proximity. The catalytic activity of cellulases was elevated after being assembled with these NTANi containing micelles due to the proximity effect and synergy effect.