FUNCTIONAL POLYMERSOMES FOR APPLICATION IN NANOMEDICINE

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ABSTRACT

Polymeric vesicles, or polymersomes, are highly versatile carrier systems which have found widespread application in the area of nanomedicine. In most cases polymersomes are used as closed spherical containers that effectively transport their cargo to the desired site of action in the human body. However, for certain applications differently shaped polymersomes are required, or polymersomes that are composed of a semipermeable membrane. The latter structures are of importance for the development of artificial organelles. In the past we demonstrated our ability to encapsulate enzymes in active form in the lumen of polymersomes with a bilayer which selectively allowed small substrates to diffuse in and out of the nanoreactors, whereas the enzymes were entrapped and protected. These nanoreactors were taken up by living cells, where they showed their prolonged activity. One of the shortcomings of our previous system was the non-degradable nature of the polymer shell. We now have developed a next generation of nanoreactors composed out of biodegradable components, which brings application in the field of enzyme replacement therapy closer.

Non-spherical shaped polymersomes can be of importance in applications such as vaccine development, in which the interaction of immune cells with the antigen carriers is strongly dependent on shape. One of the most intriguing morphologies other than spheres are tubular structures, as they show resemblance with bacterial topologies and would provide a larger contact surface area between particles and cells. We have developed a number of methodologies that allow us to reshape spherical vesicles in tubular ones. The ability to functionalize the particle surface makes these structures amenable for application in the immunology field.

A final example of a class of non-spherical vesicles with unusual properties are the stomatocytes. These vesicles are created under osmotic pressure using dialysis. Spherical polymersomes get indented and form an extra nanocavity which is in direct contact with the outside environment. Upon encapsulation of enzymes or catalytic nanoparticles in this nano-stomach, an anisotropic particle is created which has the ability to convert chemical into kinetic energy, and hence motion. By using point sources of chemical fuels, we were able to demonstrate that these nanomotors could move in a chemotactic fashion toward certain cell types. This could allow the development of particles with self-selecting features regarding different cells.

Key Words: (polymersomes, non-spherical, nanoreactors, nanomotors)

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