Medicine in a stable shell

PhD candidate Riahna Kembaren has made a micelle that protects medicines as they travel through the bloodstream.

Proteins such as insulin and antibodies can be injected into the blood as medicine. The effect of these therapeutic proteins depends on their three-dimensional structure. Without a shell protecting the protein, the structure changes and the protein loses its effectiveness when it enters the bloodstream. Riahna Kembaren (Physical Chemistry and Soft Matter) obtained a doctorate for chemical shells known as micelles that surround the protein and protect it as it travels through the bloodstream.

The micelles Kembaren used are complex coacervate core micelles (C3Ms). These core micelles form easily from a solution of polymers (chains of units) and the protein that needs to be protected, thanks to a difference in the electric charges of the protein and polymer. The polymers have a positive charge at one end and the proteins a negative charge. When you mix them, they bind together in the core of the micelle. The opposite ends of the polymers stick outwards and form a protective shell around the core. But dilution and contact with salt can still cause the micelles to disintegrate in the blood, so Kembaren added amine groups to the polymer chains. A cross-linker was used to make the amine groups form crosslinks in the core of the micelle. That network made the micelle much more stable.

The micelle only disintegrates in certain conditions

Destination

Once the micelle has reached its destination, for example a tumour cell, it should disintegrate so that the protein can do its work. Tumour cells have a low pH and a high concentration of glutathione. The micelle can be designed specifically to disintegrate in these conditions. That lets cancer be treated in a precise manner by packing antibodies in micelles that only open up when they encounter a cancer cell. SS