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Smart drug delivery via thermo-triggered squirting

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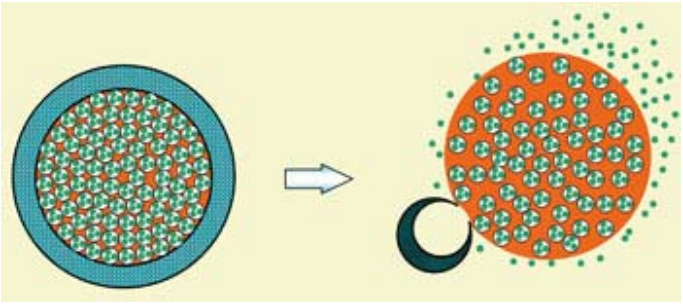
Chinese researchers have developed a method for delivering nanoparticles to a specific site of action using temperature-triggered squirting.

Nanoparticles are becoming more widespread for disease diagnosis and therapy but protecting them from degradation and delivering them to target tissue is still a challenge. Some promising drug delivery systems exhibit low physical and chemical stabilities causing them to leak or deliver the nanoparticles too early. Now Liang-Yin Chu and colleagues, from Sichuan University, have developed hydrogel capsules that protect the nanoparticles, and release them only in response to a change in temperature.

Chu encapsulated the nanoparticles in a water/oil emulsion inside a NIPAM-based hydrogel. Heating the capsules above a critical temperature triggers rapid shrinkage, which increases the internal pressure. Because the hydrogels have a low mechanical strength, the capsule violently ruptures, squirting the nanoparticles out. Chu says the inspiration for these nanoparticles bombs came from plants, such as the squirting cucumber (*ecballium elaterium*), that eject their seeds into the air by sudden contraction of their walls.



Eruption of the capsule releases the nanoparticles on target

The key to the site-specific delivery is the use of a remote trigger (temperature) to tune exactly when and where the capsules rupture. This allows the release of the drug at exactly the right time and place. Crucially, Chu has been able to tune the temperature at which this squirting happens to above body temperature, so the capsules can be used in the body. Local thermotherapy at the target site, using microwave, ultrasound or infrared irradiation could be used to trigger the nanoparticle release.

Chu is keen to stress that the force at which the nanoparticles are ejected is also important, 'some biological tissues present diffusion obstacles for nanoparticles and/or their surrounding media are quite viscous, and so higher initial momentum for the nanoparticle delivery is required,' he explains.

The team now plan to reduce the size of the capsules so they can be used in the body. Zhibing Hu, an expert in the development of hydrogel materials for drug delivery saw great potential in the system, saying that 'in principle, the same technology can also be applied to controlled drug release once the nanoparticles are replaced by a specific drug.'

Jon Watson

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Smart thermo-triggered squirting capsules for nanoparticle delivery
Li Liu, Wei Wang, Xiao-Jie Ju, Rui Xie and Liang-Yin Chu, *Soft Matter*, 2010
DOI: 10.1039/c002231d

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