Nanoparticle research could enhance drug delivery through skin

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Scientists at the University of Southampton have identified key characteristics that enhance a nanoparticle's ability to penetrate skin, in a milestone study which could have major implications for the delivery of drugs.

Nanoparticles are up to 100,000 times smaller than the thickness of a human hair and drugs delivered using them as a platform, can be more concentrated, targeted and efficient than those delivered through traditional means.

Although previous studies have shown that nanoparticles interact with the skin, conditions in these experiments have not been sufficiently controlled to establish design rules that enhance penetration.

Now a multidisciplinary team from the University has explored changes in the surface charge, shape and functionality (controlled through surrounding molecules) of gold nanoparticles to see how these factors affect skin penetration.

"By creating nanoparticles with different physicochemical characteristics and testing them on skin, we have shown that positively charged nanorod shaped, nanoparticles are two to six times more effective at penetrating skin than others," says lead author Dr Antonios Kanaras. "When the nanoparticles are coated with cell penetrating peptides, the penetration is further enhanced by up to ten times, with many particles making their way into the deeper layers of the skin (such as the dermis)."

Establishing which characteristics contribute to penetration is also important in discovering ways to prevent potentially toxic nanoparticles in other materials, such as cosmetics, from entering the skin.

The research, which has been published in the journal *Small*, drew on the medical expertise of Dr Neil Smyth and Dr Michael Ardern-Jones, as well as contributions from physicist Professor Otto Muskens. PhD student Rute Fernandes conducted the experimental work.

"Our interest is now focused on incorporating these findings into the design of new nanotechnological drugs for transdermal therapy," says Dr Kanaras. "We welcome the opportunity to work with external partners in industry and government in order to achieve this."

Provided by University of Southampton