Our health: New focus on the synergy effect of nanoparticles

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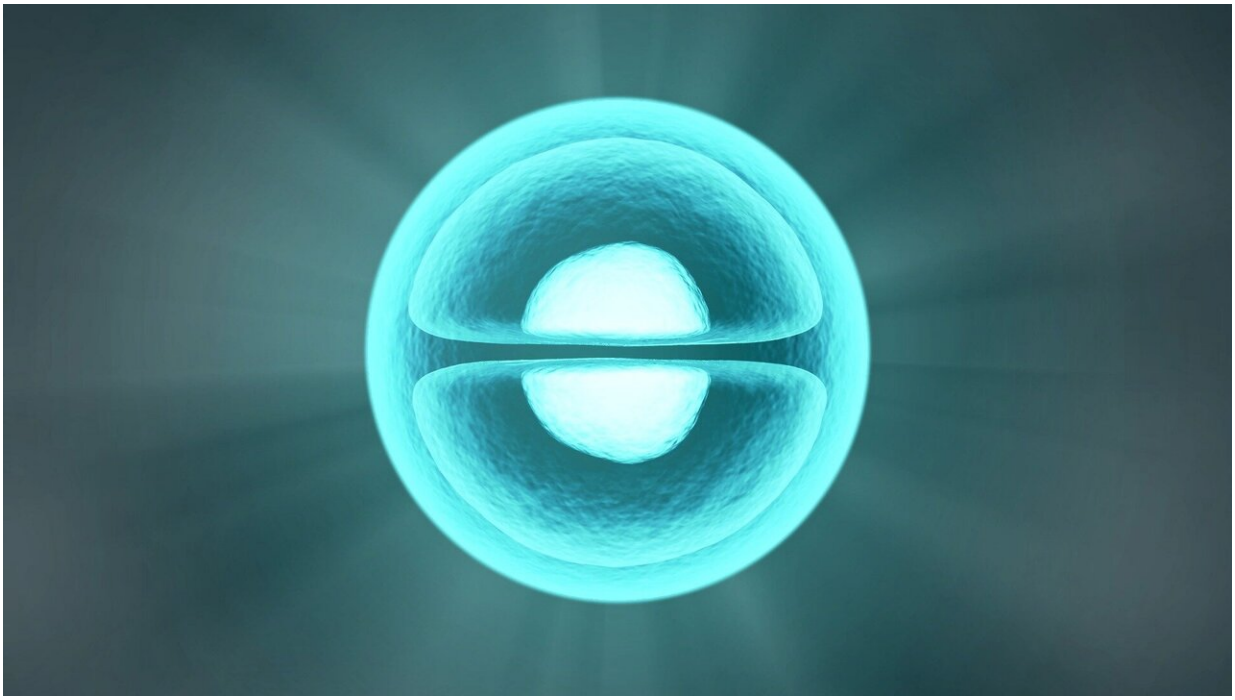

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Nanoparticles are used in a wide range of products and manufacturing processes because the properties of a material can change dramatically when the material comes in nano-form.

They can be used, for example, to purify wastewater and to transport medicine around the body. They are also added to, for example, socks,

pillows, mattresses, phone covers and refrigerators to supply the items with an antibacterial surface.

Much research has been done on how nanoparticles affect humans and the environment and a number of studies have shown that nanoparticles can disrupt or damage our cells.

This is confirmed by a new study that has also looked at how cells react when exposed to more than one kind of nano particle at the same time.

The lead author of the study is Barbara Korzeniowska from the Department of Biochemistry and Molecular Biology at SDU. The head of research is Professor Frank Kjeldsen from the same department.

"Throughout a lifetime, we are exposed to many different kinds of nano-particles, and we should investigate how the combination of different nano-particles affects us and also whether an accumulation through life can harm us," says Barbara Korzeniowska.

She herself became interested in the subject when her little daughter one day was going in the bathtub and got a rubber duck as a toy.

"It turned out that it had been treated with nano-silver, probably to keep it free of bacteria, but small children put their toys in their mouths, and she could thus ingest nano-silver. That is highly worrying when research shows that nano-silver can damage human cells," she says.

In her new study, she looked at nano-silver and nano-platinum. She has investigated their individual effect and whether exposure of both types of nanoparticles results in a synergy effect in two types of brain cells.

"There are almost no studies of the synergy effect of nano particles, so it is important to get started with these studies," she says.

She chose nano-silver because it is already known to be able to damage cells and nano-platinum, because nano-platinum is considered to be so-called bio-inert; i.e. has a minimal interaction with human tissue.

The nanoparticles were tested on two types of brain cells: astrocytes and endothelial cells. Astrocytes are supporter cells in the central nervous system, which i.a. helps to supply the nervous system with nutrients and repair damage to the brain. Endothelial cells sit on the inside of the blood vessels and transport substances from the bloodstream to the brain.

When the endothelial cells were exposed to nano-platinum, nothing happened. When exposed to nano-silver, their ability to divide deteriorated. When exposed to both nano-silver and nano-platinum, the effect was amplified, and they died in large numbers. Furthermore, their defense mechanisms decreased, and they had difficulty communicating with each other.

"So even though nano-platinum alone does not do harm, something drastic happens when they are combined with a different kind of nano-particle," says Frank Kjeldsen.

The astrocytes were more hardy and reacted "only" with impaired ability to divide when exposed to both types of nano-particles.

An earlier study, conducted by Frank Kjeldsen, has shown a dramatic synergy effect of silver nanoparticles and cadmium ions, which are found naturally all around us on Earth.

In that study, 72 % of the cells died (in this study it was intestinal cells) as they were exposed to both nano-silver and cadmium ions. When they were only exposed to nano-silver, 25% died. When exposed to cadmium ions only, 12% died.

"We are involuntarily exposed—Little is known about how large concentrations of nano-particles are used in industrial products. We also do not know what size particles they use—size also has an effect on whether they can enter a cell," says Barbara Korzeniowska and continues:

"But we know that a lot of people are involuntarily exposed to nano-particles, and that there can be lifelong exposure."

There are virtually no restrictions on adding nanoparticles to products. In the EU, however, manufacturers must have an approval if they want to use nanoparticles in products with antibacterial properties. In Denmark, they must also declare nano-content in such products on the label.

More information: Barbara Korzeniowska et al, The Cytotoxicity of Metal Nanoparticles Depends on Their Synergistic Interactions, *Particle & Particle Systems Characterization* (2020). DOI: 10.1002/ppsc.202000135

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