20c Oxide Nanoparticle Uptake in Human Lung Fibroblasts

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Nanoparticles have become a polarizing issue beyond the scientific community and widespread fear of possible negative impacts of anthropogenic particle emissions has even triggered calls to ban nanotechnology per se.

Rapidly growing reports on novel applications of nanoparticles fail to alleviate the often cited public unease towards the invisible technology. Spectacular findings of nano-materials in the bodies of rats after exposure to carbon nanotubes or titania nanoparticles are in sharp contrast to a series of successful market introductions of consumer goods and slow legislation. While semiconductor or metallic nanoparticles are mainly used in the fabrication of components and a risk of exposure to humans is limited, oxide nanoparticles have applications that reach far into our everyday life. During production or nanoparticle handling, dust uptake through the lung has raised concerns of asbestos-like toxic effects. Studies on degradable polymer nanoparticle, surface-modified particles and quantum dots as fluorescence labels indicate that other small particles may also exhibit high mobility within human cells. Despite the prominence of oxide nanoparticles in the current research, exploration of their interactions with living cells remains at a very early stage. This reflects, in part, the inherent difficulties of detecting untreated nanoparticles at relevantly low concentrations.

We have therefore developed a method to measure nanoparticle uptake in human lung fibroblasts at physiologically relevant concentrations (100 ng ml^{-1}). The oxide nanoparticles uptake was analyzed in time dependence with different size ranges and different exposure concentrations. We further applied transmission electron microscopy shows particles in the cells and permits to draw conclusion from the manner particles penetrate in fibroblasts. Based on these results a simple model of particle uptake was developed on the basis of physically measurable parameters.

Fig 1. Transmission electron micrograph of ceria nanoparticle before uptake in a human lung fibroblast cell.