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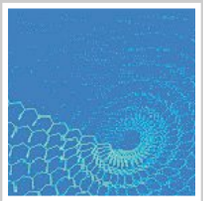

Polymer and Colloid Highlights

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What We Talk about when We Talk Nanoparticle–Cell Interaction

Sandor Balog*[a], Thomas Moore[a], Barbara Rothen-Rutishauser[a], and Alke Petri-Fink*[ab]

*Correspondence: Dr. S. Balog; Prof. A. Fink, [a]Adolphe Merkle Institute, [b]Chemistry Department, University of Fribourg, CH-1700 Fribourg, Switzerland, E-mail: sandor.balog@unifr.ch; alke.fink@unifr.ch

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Engineered nanoparticles (NPs) hold both much promise and raise safety concerns. As a consequence, a new field investigating the cellular interactions of NPs has emerged. Before NPs interact with living cells/organisms, their surfaces are exposed to biological fluids such as cell culture medium, blood, or lung fluid, all of which are multicomponent environments containing electrolytes, proteins, and lipids, among others. Most NPs are prone to interact swiftly with these components, which may result in an altered NP surface. Consequences of such an encounter include *e.g.* aggregation or oxidative dissolution, both of which can have an impact on cellular interaction.

The influence of physicochemical properties of NPs on cellular interaction is routinely assessed using *in vitro* systems and applies central concepts brought to maturity by cell biology, toxicology and pharmacology. The classic approach of the dose–response relationship however cannot be applied to NPs without adaptation, for NPs exhibit a higher level of complexity and their pristine physicochemical properties may evolve and considerably change in a physiological environment. Plus, their hydrodynamic properties are considerably different from those of small molecules, affecting both *in vitro* and *in vivo* dose–response profiles. Beside administration there are at least three rate-limiting factors that define the *in vitro* dose-response profiles: i) arrival of NPs to the cells adhering to the bottom of the cell culture dish, ii) adherence to the cell membrane, and iii) internalization. All these are nontrivial functions of the particle's size and surface properties. Another peculiarity is the metric of the administrated dose, which ideally must be expressed in more than one way: number, mass, and surface area. While the conversion from one to the other is straightforward when NPs are uniform, polydispersity eliminates this convenience. There is still more however to consider, since many experimental techniques used to quantifying dose are not based on primary properties (*e.g.* mass of NPs) but on measurable properties (*e.g.* optical extinction of NPs). Such measurable properties are to be used to characterize the primary properties *via* mathematical relationships, which might further change in the biological environment. To summarize: To understand the interaction of engineered NPs with biological systems, they must be characterized not only in their pristine state but at each and every step of the journey they undertake in a complex biological environment. This requires the merger of a body of techniques of diverse disciplines, including physical, chemical, and biological sciences.

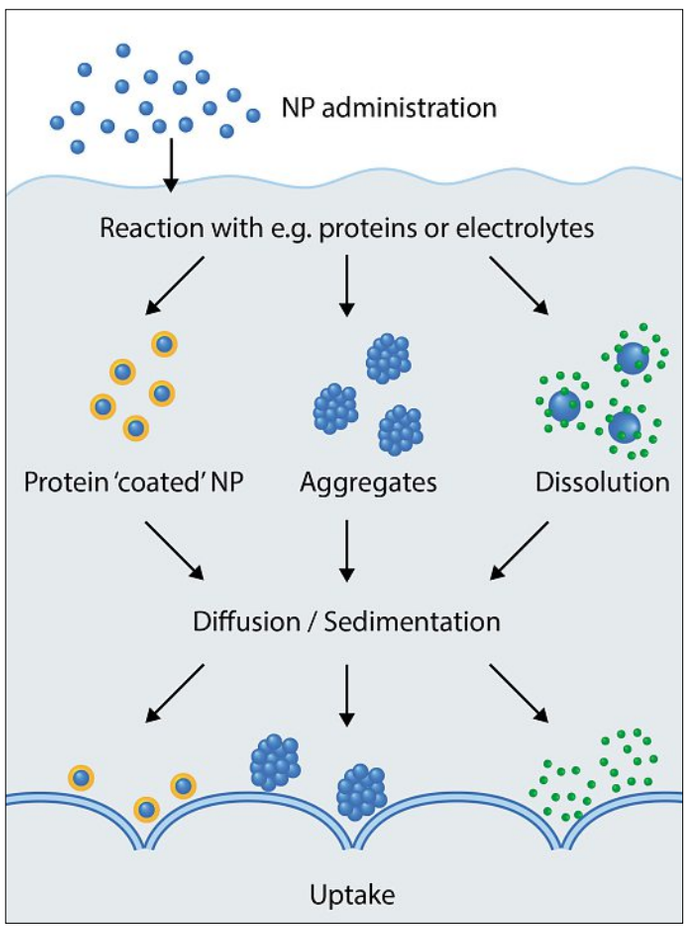

Fig. 1. From vial to cell, a schematic representation.

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If you are interested in submitting a new highlight, please contact: Prof. Dr. Markus Niederberger, Department of Materials, ETH Zürich, E-mail: markus.niederberger@mat.ethz.ch, Tel.: +41 44 633 63 90