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The Role of the Biomolecule Corona in Determining Biocompatibility of Nanoscale Materials

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Abstract

It is increasingly recognized that interactions between nanomaterials and available biomolecules lead to acquisition of a corona of biomolecules around the nanomaterials that provides the particles with a biological or environmental "identity" and determines their subsequent uptake, distribution, localization and impacts on living systems. The nature of the acquired corona depends on the available biomolecules and thus will be different depending on the route of exposure (e.g., inhalation versus ingestion) and the organisms under investigation (e.g., mouse, daphnids, plants etc.). To date, there has been considerable focus on proteins, however, another important class of biological chemicals have been largely overlooked in the efforts to understand and predict the interactions of nanomaterials with living organisms, namely metabolites, which are also involved in signaling cascades and toxic responses in biological systems. Methods to explore both protein and metabolite coronas, and the protein-protein and protein-metabolite interactions involved in forming and stabilizing the corona are needed. Emerging research is also exploring the role of corona evolution, and shedding of proteins from the corona following uptake into cells is providing new insights into the indirect toxicity effects that can arise from nanomaterials, which can be viewed as another form of Trojan-horse effect. The role of the corona and its evolution in uptake and transformation of nanoparticles in a range of biological systems will be demonstrated in this talk, including in mediating nanoparticle transcytosis across an in vitro Blood-brain barrier model, in exploring toxicity and repair mechanisms induced in response to nanoparticle exposure in daphnia, and in mediating uptake and impacts of nanomaterials in plants.