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Nanoscale interface between engineered matter, and living organisms: Understanding the biological identity of nanosized materials

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Nanoscale materials can interact with living organisms in a qualitatively different manner than small molecules. Crucially, biological phenomena such as immune clearance, cellular uptake and biological barrier crossing are all determined by processes on the nanometer scale. Harnessing these endogeneous biological processes (for example in creation of new nanomedicines or nanodiagnostics) will therefore require us to work on the nanoscale. This ensures that nanoscience, biology and medicine will be intimately connected for generations to come, and may well provide the best hope of tacking currently intractable diseases.

These same scientific observations lead to widespread concern about the potential safety of nanomaterials in general. Early unfocussed concerns have diminished, leaving a more disciplined and balanced scientific dialogue. In particular a growing interest in understanding the fundamental principles of bionanointeractions may offer insight into potential hazard, as well as the basis for therapeutic use.

Whilst nanoparticle size is important, the detailed nature of the nanoparticle interface is key to understanding interactions with living organisms. This interface may be quite complex, involving also adsorbed proteins from the biological fluid (blood, or other), leading to a 'protein corona' on the nanoparticle surface that determines its "biological identity". We discuss how this corona is formed, how it is a determining feature in biological interactions, and indeed how in many cases can undermine efforts at targeting nanoparticles using simple grafting strategies. Thus, nanoparticle interactions with living organisms cannot be fully understood without explicitly accounting for the interactions with its surroundings, i.e. the nature of the corona.

Biography

Kenneth Dawson is Director of the Centre for BioNano Interactions (CBNI). The scientific focus of this Centre is to understand interaction of nanoparticles with living systems (www.cbni.eu). The Centre seeks to clarify the controlling factors for those interactions, to support applications in nanotheraputics and nanosafety. Professor Dawson is Chair of Physical Chemistry, Chairman of the National BioNanoscience Action, and co-ordinator of the European Infrastructure in the arena. He has experience in the management of large scale EU projects, including multi-sectoral cross-disciplinary research projects, and other international programs. He has received several international prizes, including the 2007 Cozzarelli prize from the National Academy of Sciences USA, as well as IBM, Packard, Canon, Sloan and Dreyfus prizes. Prof. Dawson's professional roles include representing Ireland on the OECD and ISO working groups on standards for Nanotechnology. He Chairs the launch of the International Alliance on NanoEHS Harmonisation (http://nanoehsalliance.org/), a new global partnership of scientists from EU, US, and Japan. He is currently Editor of Current Opinion in Colloid Science, Senior Editor of Physica, Associate Editor of Journal of Nanoparticle Research, and former President of the European Colloid and Interface Society. He also advises on nanoscience matters in the EU New Risk Committee of the European Commission, and the Advisory group of the European Medicines Agency.